POPULAR SCIENCE

FOUNDED MONTHLY 1872

OCTOBER

NOW 15¢

NEW INVENTIONS
MECHANICS
THE HOME WORKSHOP
MONEY MAKING IDEAS
350 PICTURES

See Page 43

Flame Ate Those Fuses Fast!

While I was trapped in the Dark with 380 Sticks of Dynamite"

"What a spot to be in... like a blind bug in a snake-hole, with some youngster shoving a lighted cannon-cracker down," writes George B. McIntyre, old-time tungsten miner.

"But let me go back to the beginning and explain —When you are spitting (lighting) blast fuses under ground, the thing to do is to get them going and get away!

"This time was Monday, and you know how Mondays are. I had a round of 24 holes to spit, 380 sticks of 60 and 40 per cent dynamite at the ends of those fuses, all of different lengths to give me time to get away.

"I got the fuses all going with my miner's lamp...and as I turned to run for the manway, I stumbled, the lamp fell from my hand into the ore chute at my feet and clattered away.

"There I was, trapped in a black silence punctuated by 24 glowing, hissing fuses. Three hundred feet to the manway, but in that inky rock-strewn passage, it might as well have been 300 miles . . . and in a matter of seconds she'd let go. Thousands of tons of ore would seal my tomb . . . after I was blown to bits by the charge itself.

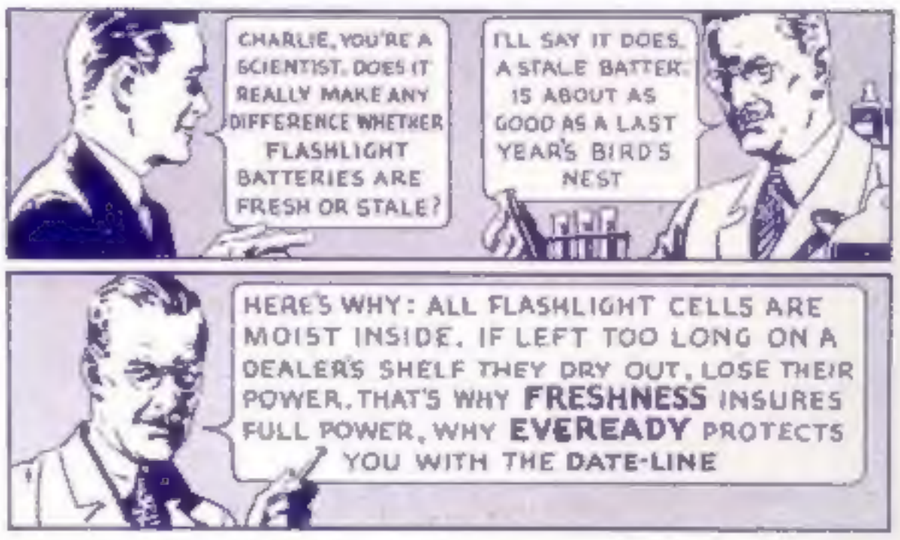
"Nothing of this kind had ever happened to me before in all my life underground . . . but for years I had carried an Eveready pocket flashlight . . . and now its moment had come! I don't know how long the batteries had been in that flashlight . . . months at least. But when my life depended on them, they came through! Once I could see my way, escape was easy, where it had been impossible a second before. And believe me, when I read your ads about FRESH Eveready Batteries, I said 'Amen, Brother'! DATED Eveready batteries saved me from a horrible death because they were *fresh* and full of life when I bought them so long before.

"This *freshness* may not seem so important when you buy your batteries, but you never know when it may become the most important thing in the world."

Geo B McIntyre

EVEREADY BATTERIES ARE *FRESH* BATTERIES

National Carbon Co., Inc., 30 East 42nd St., New York

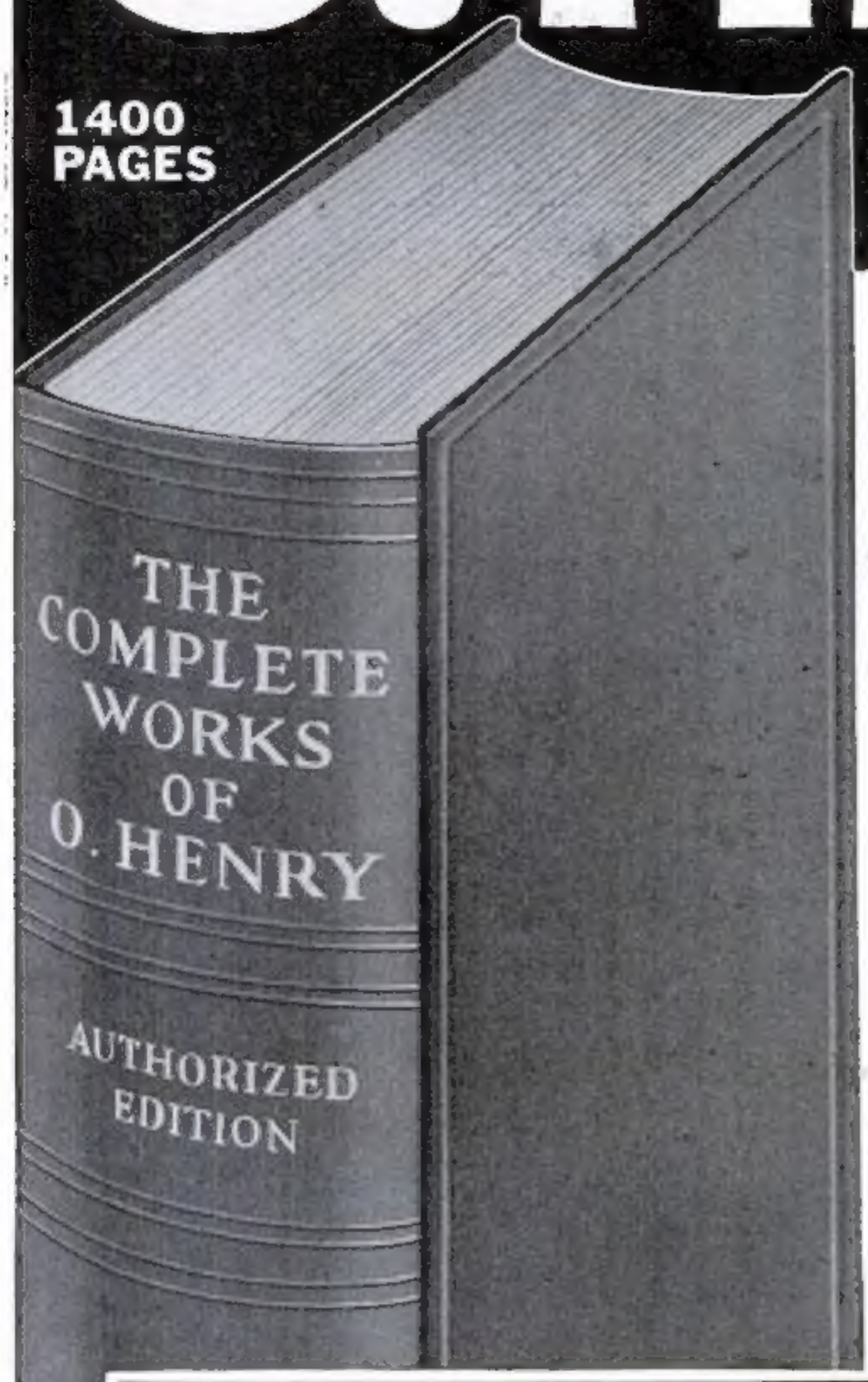


YOURS TO READ FREE!

O. HENRY

COMPLETE IN ONE VOLUME

273 THRILLING STORIES



IF YOU LIKE IT KEEP THIS GREAT $5.00 BOOK *for only* $1.00

A GENUINE $5.00 VOLUME

Begin any O. Henry story and you will read it through to the end! He captures your imagination at the start, sweeps you on through one exciting adventure after another, and leaves you breathless with astonishment and delight.

Think of getting EVERY ONE of the stories ever written by the greatest story-teller in American literature! You get all the romance and pathos of "A Service of Love," all the humor of "The Rubaiyat of a Scotch Highball," all the drama of "The Furnished Room," all the sheer enjoyment of 273 immortal tales—hours and hours of delightful reading.

Formerly published in a many-volume edition at a good high price, ALL of O. Henry's stories, his poems and essays, with biographical information about the author, can now be yours in ONE exquisite volume of 1400 pages! Clearly printed and beautifully bound in rich deep blue cloth artistically stamped in gold, regular value $5.00. But our special offer gives you this great book for only $1.00 if you act promptly! You send no money now and none at all if after FREE EXAMINATION you don't think this is even more of a book bargain than we say it is.

DOLLAR BOOK CLUB MEMBERSHIP IS *FREE*

. . . *and it brings you* AMAZING BARGAINS LIKE THIS

The plan of the Club is simply this: upon receipt of the attached coupon you will be sent The Complete Works of O. Henry. With this book will be the current issue of the free monthly magazine called "The Bulletin", which is sent exclusively to members of the Club. This Bulletin describes the next month's selection and reviews about thirty other books available to members only for $1.00 each. If after reading the description of next month's selection the member does not wish to purchase the book for $1.00 two weeks time is given in which to write the Club so that the book will not be included in the automatic monthly shipment and to request an alternate selection if it is desired. Thus members are privileged to purchase as many or as few books as they wish at the special price of $1.00 each.

Dollar Book Club Books are selected from the best modern books—the best fiction, biography, travel, etc., by the best authors. In past months the Club has offered books by Sinclair Lewis, Edna Ferber, W. Somerset Maugham, William McFee, H. G. Wells, Ellen Glasgow, Hugh Walpole, and many other great writers. The Dollar Book Club books are always in the "original format" which sold for 2½ to 5 times as much.

70,000 discriminating readers have enthusiastically accepted free membership in this money-saving Club. This huge membership of men and women enables the Club to offer book values unequaled by any other method of book buying. And the membership which brings you these bargains is FREE.

READ THESE FAMOUS STORIES by AMERICA'S FAVORITE STORY-TELLER

The Skylight Room	The Fool Killer
Lost on Dress Parade	A Sacrifice Hit
A Blackjack Bargainer	Past One at Rooney's
The Ransom of Red Chief	A Philistine in Bohemia
The Green Door	Cherchez la Femme
The Cop and the Anthem	Handbook of Hymen
A Lickpenny Lover	The Brief Debut of Tildy
Tamales	Transients in Arcadia
The Caliph and the Cad	The Shocks of Doom
The Enchanted Kiss	Man About Town
A Harlem Tragedy	From the Cabby's Seat

and 251 More!

Get $2.50 to $5.00 Books *for only* $1

TAKE THEM ONLY IF AND WHEN YOU WANT THEM

When the Rattlesnake Struck

"Judge: When you sent me up for four years you called me a rattlesnake. Maybe I am one—anyhow you hear me rattling now. One year after I got to the pen, my daughter died of—well they said it was poverty and the disgrace together. You've got a daughter, Judge, and I'm going to make you know how it feels to lose one. I'm free now, and I guess I've turned rattlesnake all right. Look out when I strike!"

What a beginning for a story—and what a STORY! DON'T miss it!

SEND NO MONEY—Just Mail the coupon

May we *prove* to you that Dollar Book Club values are really amazing? Let us send you for free examination the great $5.00 value O. HENRY COMPLETE. When you see this splendid book and think of owning it for only $1.00 you will realize the value of free membership in this popular Club. This is a demonstration *at our risk and expense*. If you are not delighted with the book and surprised at this sensational bargain you may return the book and owe nothing. Don't miss this opportunity to get a FREE MEMBERSHIP in this money-saving Club. Mail the coupon now.

DOUBLEDAY ONE DOLLAR BOOK CLUB, Dept. 10 PSM, Garden City, N.Y.

This Coupon Brings O. HENRY to Read FREE

DOUBLEDAY ONE DOLLAR BOOK CLUB
Dept. 10 PSM, Garden City, New York

Please enroll me free for one year as a Dollar Book Club member and send me at once The Complete Works of O. Henry which I will examine and read free for three days. With this book will come my first issue of the free monthly Club magazine called "The Bulletin" describing the one dollar bargain book for the following month and several other alternate bargains. Each month I am to have the privilege of notifying you in advance if I do not wish the following month's selection and whether or not I wish to purchase any of the alternate bargains at the special Club price of $1. each.

If I keep The Complete Works of O. Henry, I will send you $1. plus a few cents handling and shipping charges as full payment. The purchase of books is entirely voluntary on my part. I do not have to accept a book every month or a minimum during my year's membership. And I pay nothing except $1.00 for each selection received plus a few cents handling and shipping costs.

Name.....

Street and No.....

City.....State.....

Occupation.....

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
GEORGE H. WALTZ, JR., *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 129 · NUMBER 4
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
353 Fourth Ave., New York

TABLE OF CONTENTS for OCTOBER, 1936

October, 1936, Vol. 129, No. 4. **Popular Science Monthly** is published monthly at 353 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; C. D. Freeman, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

Single copy, 15 cents. Yearly subscriptions to United States, its possessions, and Canada, $1.50; foreign countries, excepting Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. The use of Popular Science Monthly articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

4900 Chemical Formulae

In This One Indispensable Book

In this one big book you have at your fingertips practical commercial formulae for making thousands of useful products for your own use and for profitable manufacture. Brand new, encyclopedic in scope, arranged for quick reference, it is exactly the book that every commercial chemist, large or small, has long wanted. 600 Meaty Pages of formulae including many patented, scarce and little known processes, many published for the first time. *Collected by over 60 outstanding industrial chemists and technicians—every formula proved successful by actual test and experience.*

Covers Hundreds of Industries

Thousands of Products

You will find, in The Chemical Formulary, methods for making or using:

Abrasives	Fertilizer	Matches
Adhesives	Fireproofing	Metallic Printing
Air Conditioning	Fireworks	Matrix, Rubber
Alloys	Fluxes	Mirrors
Anti-rusts	Fly Killer	Nickel Plating
Aromatics	Food Specialties	Oil Sun-Tan
Asphalt	Gems, Artificial	Ointments
Bronze Lacquers	Glass Polish	Paints
Candles	Glues	Patent Leather
Candy Glaze	Gold, Plating	Photographic Specialties
Carbonizing	Grease, Lubricating	Polish, Auto
Catalysts	Hair Setting Liquids	Porcelain
Celluloid	Hair Tonics	Preservatives
Cement	Incense	Printing
Cream, Cold	Inks	Refrigerants
Coffee Substitutes	Insulation	Rubber, Synthetic
Colors for Oils	Jams and Jellies	Safety Glass
Decolorizing Preparations	Kalsomine	Shaving Cream
Dental Cement	Lacquers	Soaps
Depilatories	Latex Paint	Solvents
Disinfectants	Leather Polishes	Stencils
Dyes	Liniment	Tooth Paste
Electrotyping	Liquors	Waterproofing
Etching Compounds	Lubricants	Zinc Etching
Explosives		Zinc Plating

and thousands more.

ONE FORMULA ALONE MAY BE WORTH HUNDREDS OF DOLLARS TO YOU

Every formula in this book is of practical, commercial value. The volume is not merely a collection of "household stunts" or experiments for the amateur, but a mine of money-making ideas for everyone concerned with commercial chemistry. In addition, you will find it a quick-reference book for a vast amount of information that you need in your daily work. Send for your copy today.

EXAMINE IT FREE

Send No Money. Mail This Coupon

D. VAN NOSTRAND CO., Inc.
250 Fourth Ave., New York.

Send me on approval The Chemical Formulary. Within 5 days after I receive it, I can return it to you and owe nothing. If I keep it I will send you $2.00 as first payment and I will pay $2.00 monthly thereafter for 2 months—$6.00 in all. (5% discount for cash. Same return privilege). (P.S.M. 10-36)

Name .....

Address .....

City ..... State .....

Reference .....

Address .....

FOR FREE CATALOG of best books of practical instruction and technical information check here ☐

NEW ENLARGED

Revised throughout, greatly extended in scope, with a wealth of NEW MATERIAL in all sections. The subjects of pulleys, gears, the use of the slide rule, and weights and measures have been greatly lengthened. Valuable new sections deal with the topics of strength of materials, papering, glazing, and radio. Ample new material has been furnished on machine shop practice and sheet metal work. Finally, an entirely new treatment covers exhaustively the great field of business mathematics. In its new form, more than ever before, this book will simplify your most important and puzzling problems.

No Increase in Price

900 Pages. Lavishly illustrated. Strong Cloth Binding. Page Size 5½ x 8 Inches

THIS COMPLETE, SIMPLE, PRACTICAL COURSE FOR SELF-INSTRUCTION WILL QUICKLY GIVE YOU

A Complete Mastery of MATHEMATICS

Prepare now to advance yourself to an important job by *Mathematics Training*. *Mathematics* is the foundation of all mechanical and scientific work, and of all business or industry based on science. Without this essential knowledge even the most capable man is left behind while others forge ahead to better jobs, bigger contracts, more money. You need mathematics to solve technical problems and to improve, speed up and check on your work and the work of others.

Now you can learn mathematics by an easy, inexpensive and time-saving method. A very simple and extremely interesting course in book form has been prepared for you by an expert who has devoted a lifetime to teaching practical men the fundamentals of this important subject.

MATHEMATICS FOR SELF-STUDY

By J. E. Thompson, B.S., A.M.,
Dept. of Mathematics, Pratt Institute

These books start right from the beginning with a review of arithmetic that gives you all special short-cuts and trick methods that save countless hours of your time. Then they go right into higher mathematics and show you how simple it is when an expert explains it for you. In no time at all you will be tackling with ease the most difficult questions on this subject.

A Complete Course and Reference Library in 5 Volumes

Arithmetic
Algebra
Geometry
Trigonometry
Calculus

1598 Pages Illustrated

An Expert's Simplified Methods

Mr. Thompson, the author of these books, has had many years' experience in mathematical training. He presents each practical method and problem in the clearest, simplest way. He gets right down to the kind of information that you need in your daily work.

Send No Money
Mail This Coupon for FREE EXAMINATION

D. Van Nostrand Co., Inc.
250 Fourth Ave., New York

Send me MATHEMATICS FOR SELF-STUDY in 5 volumes. Within 10 days I will either return the books or send you $2.95 as first payment and $2.00 per month for 3 months—total $8.95 (5% discount for cash). (P.S.M. 10-36)

Name .....

Address .....

City and State .....

Reference .....

Address .....

FOR FREE CATALOG of best books of practical instruction and technical information check here ☐

Every Needed Fact, Figure, Formula— Every Shortcut and Special Method *in the* WHOLE FIELD OF MATHEMATICS

For the first time you can have this wealth of practical mathematical information, covering every trade and business, condensed into one handy book for quick reference. This volume puts right at your finger tips instant facts and formulas for making every kind of mathematical calculation. From hundreds of different sources, this priceless information has been gathered together, boiled down into brief, simple language, and applied to actual problems. Every man in business, every man in the mathematical trades, every man who ever uses a tool or has to make calculations or estimates in office, shop, or home, will find here a treasury of money-making, money-saving ideas.

THE HANDBOOK OF APPLIED MATHEMATICS

No previous knowledge of mathematics is needed. No study is required. The specific information you want is easy to find, by looking it up in the index. The book takes up every trade and gives you practical methods, easily-worked formulas for solving every problem. Thousands of specific examples show you just how to make your calculations. If your work involves mathematics in any way this complete reference handbook is an indispensable part of your equipment. It is an amazing time saver for any one concerned with engineering, architecture, electricity, mechanics, construction, automobiles, machinery, printing, or any other industrial work; or with accounting, auditing, manufacturing, costs, taxes, or any other business mathematics. No practical man, no house owner who makes an occasional repair, no one who has a home work-shop can afford to be without the valuable information quickly found in this book.

See How Thoroughly It Covers the Needs of YOUR Work

Arithmetic (including Slide Rule)	Plumbing
Algebra	Paper Hanging
Geometry	Glazing
Trigonometry	Heating
Weights and Measures	Machine Shop
Mechanics	Automotive Shop
Excavations and Foundations	Sheet Metal Work
Concrete	Electricity (D.C. and A.C.)
Brickwork	Radio
Carpentry and Building	Print Shop
Lathing and Plastering	Business Mathematics
Painting	Accounting

Examine It FREE

Send No Money—Mail Coupon

D. VAN NOSTRAND CO., Inc.
250 Fourth Ave., New York

Send me on approval *The Handbook of Applied Mathematics*. Within 5 days after I receive the book, I can return it and owe nothing. If I keep it, I will send you $2.00 as first payment and I will pay $2.00 monthly thereafter for 2 months—$6.00 in all. (5% discount for cash.) (P.S.M. 10-36)

Name .....

Address .....

City ..... State .....

Reference .....

Address .....

FOR FREE CATALOG of best books of practical instruction and technical information check here ☐

POPULAR SCIENCE MONTHLY FOR OCTOBER, 1936

LO—THE POOR INDIAN!

TWO PUFFS from that soggy pipe full of fire-water tobacco and another redskin bit the dust. We tell travelers as well as stay-at-homes that the true pipe of peace should be regularly cleaned, and packed with nothing but inoffensive Sir Walter Raleigh Smoking Tobacco. It's a secret blend of definitely milder Kentucky Burley leaf. Burns slow, pacifies the tenderest tongue and spreads a most delightful and winning fragrance. We're so blamed proud of Sir Walter Raleigh we wrap it in heavy gold foil for extra freshness. Ever treated yourself to a tin? Only 15¢.

SWITCH TO THE BRAND OF GRAND AROMA

FREE booklet tells how to make your old pipe taste better, sweeter; how to break in a new pipe. Write for copy today. Brown & Williamson Tobacco Corporation, Louisville, Kentucky, Dept. Y-610

DO YOU GET CREDIT for your GOOD IDEAS?

Greatest bargain in 10 years

ANY REMINGTON PORTABLE NOW 10¢ A DAY

RIGHT NOW, you can get a brand new Remington Noiseless Portable, the typewriter that speaks in a whisper, for only 10¢ a day. Here is a typewriter with such a lightning-fast action that words seem to flow from it without effort. Used by famous authors, business and professional men. It is so quiet that you can type anywhere at any time without disturbing others. Standard keyboard. Variable line spacer, double shift key. Automatic ribbon reverse. Everything you need for complete writing equipment, PLUS THE NOISELESS FEATURE!

YOU DON'T RISK A PENNY. You can get this Remington Noiseless Portable direct from the factory for a TEN-DAY FREE TRIAL. Use it. Prove to yourself, with the FREE TYPING COURSE we send you, that you can learn to type in a few days. Then if you don't think it is the finest portable you have ever used, send it back at our expense. WE PAY ALL SHIPPING CHARGES. Or keep it and pay for it at only 10¢ A DAY. You get a typing course and carrying case absolutely FREE. Get the full details without obligation! Clip out this coupon right now, and mail it today!

10-DAY FREE TRIAL OFFER

FREE TYPING COURSE CARRYING CASE

SPECIAL FACTORY-TO-YOU OFFER MAIL TODAY!

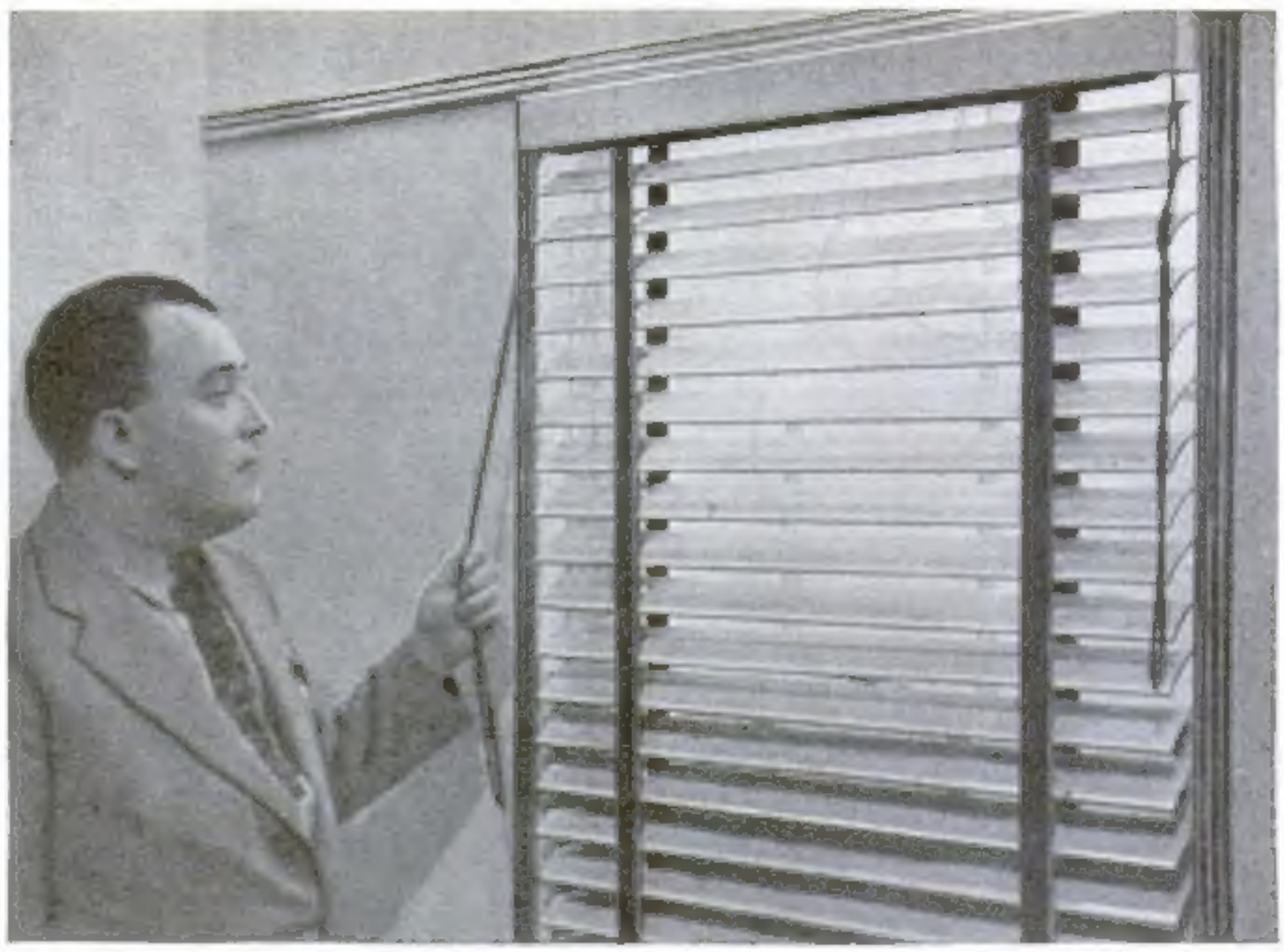
Remington Rand Inc., Dept 153-J
315 Fourth Avenue, New York, N. Y

Tell me, without obligation, how to get a New Remington Noiseless Portable, Free Typing Course and Carrying Case, for 10c a day. Send catalogue

Name_____

Address_____

City_____ State_____



Made so that its parts telescope, this metal Venetian blind can be adjusted to fit windows of almost any width

New Ideas for HOME OWNERS

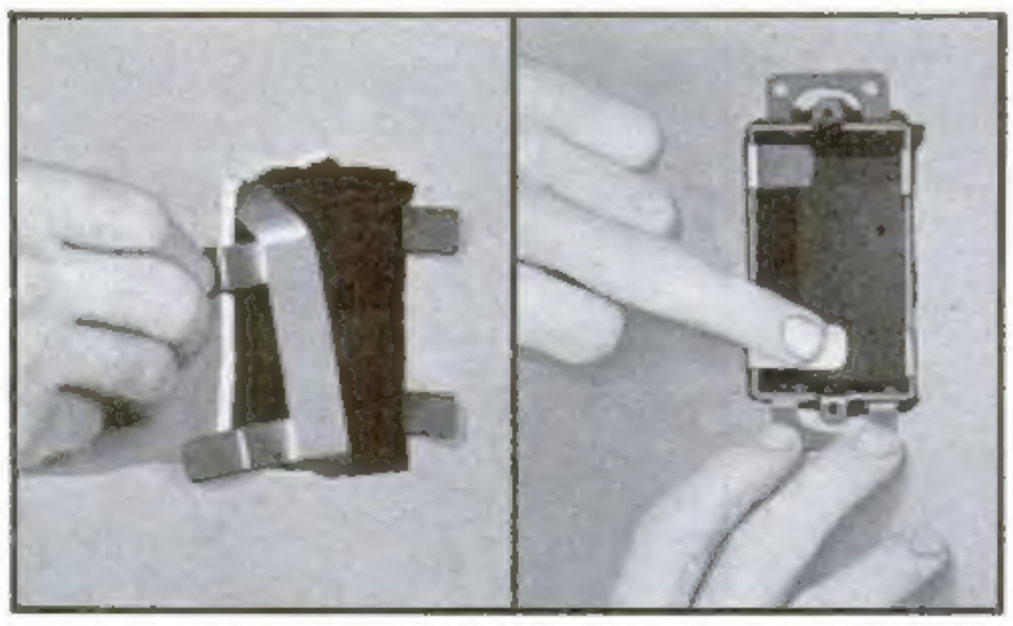
READY-MADE SHOWERS EASY TO INSTALL

THE PROBLEM of putting in a stall shower in either an old or new bathroom can be simplified by the use of one of the inexpensive ready-made units recently placed on the market. Available completely assembled or knocked down, these prefabricated shower cabinets need only be set in place and connected to the existing plumbing—a one-man job that takes very little time. Since they are complete with waterproof base and drain opening, no special concrete flooring need be laid. Available in various sizes, a suitable unit can be obtained for the existing space.

BEING adjustable in width, a new-type metal Venetian blind recently placed on the market makes it unnecessary to obtain special made-to-order units for uncommon or oversize windows. Made of pressed steel, the slats as well as the headboard and tilting board consist of two telescoping members that can be adjusted to fit windows ranging in width from twenty-seven to forty-four inches. Its metal construction eliminates any possibility of warping and a sturdy baked-on enamel coating gives the blind an attractive finish. Simplified hanger brackets make it easy to remove or replace the blind so that the units can be changed about.

SWITCH-BOX CLIPS SPEED ELECTRICAL WORK

BY MEANS of recently devised clips, wall switch boxes can be installed easily without the use of screws. Made of metal cut in the form of a long strip with two projecting fingers, the clips are inserted in the switch hole cut in the wall—one along each vertical edge. When the switch box has been put in place, the projecting fingers are bent over the edges of the box and serve to hold it rigidly in place. Because no screws or countersinking are necessary, switches can be installed in less than one third the time consumed by ordinary methods. According to the manufacturers, these approved clips can be used in any type of wall. The switch can be installed anywhere, regardless of internal wall conditions, since the two ends of each clip can be bent so as to give a firm bearing for the switch.



How the switch-box clips are used. Inserting one of the units in the box hole cut in the wall

With the switch in place, the ends of the clips are bent over the edges of the box to hold it

Questions

FROM HOME OWNERS

Q.—WE HAVE been bothered with fumes from our automatic gas-range lighter. Can we fix this ourselves so that the trouble will be permanently eliminated?—R. F., El Paso, Tex.

A.—THIS is due to the formation of carbon in the combustion chamber of the lighter. To remedy it, cut a three-quarter-inch hole in the top of the lighter cap. This keeps the flame from coming in contact with metal, and will eliminate soot and fumes entirely. To adjust the height of the flame, turn the screw on the side of the fitting near the push button. Five eighths of an inch is about right.

QUICK-DRYING VARNISH

C. C. M., DES MOINES, IOWA. With varnished floors, three days is not too much to allow for drying, but if there are children in the family, it will be difficult to keep them off the floors that long. You might try one of the quick-drying varnishes on the market. These leave the floors ready for use in about four hours.

PAINTING GALVANIZED IRON

Q.—I'D LIKE to put a protective coating on some new galvanized iron, but can't find any way of making the paint "stay put." Can you suggest some method or paint?—F. L. U., Syracuse, N. Y.

A.—NEW galvanized iron and tin are always covered with a greasy film, to which paint will not adhere properly. To remove this, wash the surface with vinegar. For the first coat, use red lead or some other metal-protective paint. Outside paint will do for the following coats.

HANDY BOARD FOR PLASTER

R. N. O'C., SANTA BARBARA, CALIF. If you have much patching to be done with plaster of Paris, it will be worth your while to make a plasterer's "hawk," using thin box material, with a broken broomstick for the handle. On this, small batches of patching plaster may be mixed and carried conveniently from one patching job to another.

HOW TO READ A GAS METER

Q.—CAN YOU tell me how I can read my gas meter?—Mrs. D. S. H., Albuquerque, N. Mex.

A.—BEGINNING at the left, write down the figure each hand has just passed on the four dials (or three, on a three-dial meter). Add two ciphers, for the reading. When a hand is between two figures, take the smaller.

MAKE YOUR OWN SHADES

R. F., LITTLE ROCK, ARK. Shade rollers can be used over again by removing the shade and tacking on new shade cloth, in exactly the same way as the old shades were fastened. You can buy the shade cloth by the yard at most department or dry-goods stores.

KEEPS CASTERS FROM FALLING

Q.—CASTERS fall out of our furniture when it is lifted. Can anything be done to keep them in place?—A. McC., El Paso, Tex.

A.—WRAP friction tape or rubber bands around the stems. To tighten a caster of the socket type, wrap tough paper or cambric around the wood where the socket fits, and glue well.

Our Readers Say

He Scents Possibilities In Olfactory Radio

AT THE end of your article "New Wonders Promised by Radio," you tucked in a prediction that flavors and odors will some day be broadcast, just as sounds are sent over the ether today. I see great possibilities in this idea. A radio program of the future may read something like this: "8:00 p.m., first strawberries of the season, broadcast from Florida. 8:15 p.m., scent of Japanese cherry blossoms, by short wave from Tokyo. 8:30 p.m., report on the livestock situation, with olfactory effects from the Chicago stockyards."—A.K., St. Petersburg, Fla.

A Cry for the Prevention Of Cruelty to Tools

VISITS to some home workshops have convinced me that W. J. Q., of Glendale, Calif., is quite right in his plea for more articles on the care and use of tools. The methods of many amateur mechanics are surprising. I have seen woodworkers try to use bench-type circular saws, with results that would bring tears to the eyes of any true lover of tools. Often the wrong-style tool is used, or else it is so dull that good work is impossible. Although I realize that the persons I saw misuse the tools were not experts, still I think that mere common sense should tell them that when a saw chokes there is some reason for it. A few pages in your magazine given to the use, care, and servicing of tools would be a help to many, myself included.—H.J.B., Seymour, Conn.

If This Be Treason, He's in Favor of It

SINCE reading your recent article "Uncle Sam Cracks Down on Spies," I have taken a special interest in the latest news of activities of foreign agents in this country. If the reports are true, those babies are even dumber than the spies you see in the movies. They go to great trouble and expense to bribe somebody who happens to have a cousin in the Navy, and what do they get?—old newspaper clippings, a group picture of the graduating class at Annapolis in 1907, and a middy blouse worn at a high-school production of "Pinafore." If that kind of junk is valuable as "secret information," I'll gladly sell to any foreign power the pile of old newspapers and magazines in my cellar. And, for an added consideration, I might throw in a photograph album containing pictures I took on my vacation, including a specially valuable snapshot of a girl in a red bathing suit on the beach at Mattituck, Long Island.—F.A., Brooklyn, N. Y.

Horizontal Walker Asks For a Lift

WITH all these inventive geniuses who are so rapidly changing our modes of working and living, why is it that no one has brought out what might be called a "horizontal elevator?" A few weeks ago, while in Washington, D. C., I was a bit astonished to find that although none of the buildings are very high, many of them cover a lot of ground. With elevators at one entrance only, it is necessary to do a lot of horizontal walking. A moving corridor in these buildings would save a lot of aching feet.—S.T.D., New York City.

All Steamed Up About Electric Trains

I'D LIKE to find, in some future issue of P.S.M., a thorough working description of an electric locomotive, such as those that are used to move trains in and out of the Cleveland Terminal. When standing close to one just before it pulled out, I noticed a hum, as though a motor-generator set were operating. Also—and this is something you'll have to figure out for yourself—*steam* escapes from them in winter.—J.E.T., Cleveland, Ohio.

From a Double Star To Sound-Fast Planes

WHILE watching the stars recently, I saw what seemed to be a double star. It was blue in color, and was in the celestial Southern Hemisphere, a little above and to one side of a dim nebula. Gazing at it for half an hour did not change the image. Probably some other reader can tell me if double stars are visible to the unaided eye, and if so, which one I saw. As to the problem presented by G.T.M., of Cambridge, Mass., asking if one would hear a plane traveling at the speed of sound, I think that the sound would be projected ahead of the plane at twice its ordinary speed, and that on retreat of the plane, it would be laid down in stationary waves. P.S.M. is tops with me, and here's for more articles on chemical industries and research; they're fine.—R.A.G., Jr., Ponce, Puerto Rico.

Amateur Decries Lack Of Television Hook-Ups

THE daily newspapers have been carrying, during the past few months, stories of successful television tests, but most of the developments have been kept secret. I noticed that one manufacturer, however, came out with a statement that hook-ups and diagrams should be published so that amateurs could start building their own sets. Everyone knows that a good many refinements in present day radio receivers are due to the inventive skill of the amateurs who built their own equipment. I don't see why the same policy of publishing hook-ups shouldn't be followed now. The industry itself will, in the end, profit by the refinements hit upon by experimenting amateurs.—J.G.C., Trenton, N. J.

Now You See It, Now You Don't

I WONDER how many other readers noticed the odd optical illusion produced by the driving wheels of the streamline locomotive shown in the photograph on page fifteen of the August issue? The two front wheels are O. K., but look at the third wheel. The longer I study it, the more it looks like a cylinder with its axis parallel to the tracks! Lighting and photography play some funny tricks.—L.A.M., Binghamton, N.Y.

Organic Chemistry Article Makes Him Take Pen in Hand

ALTHOUGH I have been a reader for several years, this is my first audible chiming-in with other chemistry enthusiasts for more articles on organic chemistry. And while I'm at it, let me voice my appreciation of the organic experiments contained in a recent issue, especially the one with paranitroacetanilide. It worked splendidly, and will be of great help in my work on analine dyes. So here's for more organic chemistry, along with continued success for your fine magazine.—B.G., New Orleans, La.

Thinks Windshield Camera Would Expose Careless Drivers

READERS sometimes suggest to you better ways of reducing automobile accidents or, at least, ways which they think would be more effective than those used at the present time. I recently read about a man down in Tennessee who used a novel and effective scheme with this end in view. He has a twin-lens camera mounted at the lower left-hand corner of his windshield. It is operated merely by touching a lever. One of the companion pictures it takes shows the general view of the road and traffic ahead. The other, focused to a more limited field, shows the cars (and their license numbers) which are involved in a traffic violation. Pictures are snapped by this Tennessee autoist whenever he happens to be behind some driver or drivers who are violating traffic regulations or common-sense rules of safety. It seems to me that this man's idea would be invaluable to police officers and insurance company inspectors who might build up a file of pictures

of traffic-violating cars. Also, if state motor-vehicle departments would reward citizens who turned in such pictures when they gave needed evidence in accident cases, the plan might become an effective deterrent to careless driving.—S P., St. Paul, Minn.

Modern Traveler a Sissy, This Old-Timer Says

HAVING inspected several of the new streamline trains, I have come to the conclusion that the railroads are pampering their passengers too much. Now I read about a Russian "luxury" train which includes a nursery car, barber shop, and bath compartments. Each passenger gets individual radio earphones, and if he doesn't like *any* program, an obsequious steward will bring him an individual phonograph with any records he desires. No wonder people don't stay at home any more, when a railroad ticket buys you such a taste of high life! It gives me a homesick feeling for the old plush-covered seats, the water cooler at the end of the car, the "news-butch," and the cinder in the eye. —R.A., San Francisco, Calif.

Silent Hummer Gets Into A Nightmare of Sounds

Your recent article "Memory Experts Made to Order," which told of mental images of sounds, recalls an amateur psychological experiment that I have never seen described in print. Frequently I find myself "humming" mentally, without making a sound, some tune I have heard. Now, the thought occurred to me not long ago, what would happen if you tried to picture mentally a note outside the range of audible pitch? The ear couldn't hear it, but couldn't the brain "sound" it just the same? To find out, I struck a note on the piano and then started mentally going down the scale from there, eager to see whether I would "run off the keyboard." To my surprise, I found myself before long repeating the same octave over and over—just as a singer, faced with a bass note beyond the range of his voice, would have to jump to the octave above. From this test, at least, it seems as if the limit of mental power to picture sounds of various degrees of pitch coincides with what the ear can hear.—S.G.V., Akron, O.

Hints from an Australian Home Workshop

MOST of my home-workshop activity is that of an odd-job man—fixing up and repairing things about the house—but when I get a chance I go back to my hobby of making sailing models. Since I like to sit at my work, I have made a strong little table that I can twist and turn so as to get at all sides of a job without getting out of my chair. The legs are fitted with stout two-inch casters, and there is a spring door stop on each leg so that the table can be anchored firmly to holes bored in the floor. I use a lot of very small bradawls and other piercing tools, and find that the handiest and safest way to keep them is to stick them into the top of a pasteboard box that has been filled with sand to keep it steady.—O.I.M., Chatswood, N.S.W., Australia.

Even We Might Play Chopsticks On Such an Organ

I'M GOING on record along with the others who want articles and instructions on organ building. Here's what I would like you to give us: Plans and specifications for an electronic organ having a range of twenty-five notes, with each key controlling one oscillating circuit, and with one tube common to all circuits so that one note could be played at a time. Also, you could give us plans for an organ on which chords can be played. Because of the separate oscillating circuits for each key this would be much more expensive to build, but its performance would justify the added expense. I am looking forward to seeing such plans.—L.L.M., Mt. Carmel, Pa.

Perhaps We Could Start An Anti-Slush Fund

HOW ABOUT doing something both popular and scientific about heavy snowfalls? Perhaps by 1980 we will have batteries of electric heating elements buried under the ground, to melt the snow as it falls. The sidewalks could be made of glass, to let the heat through, and nobody would have to wear rubbers.—C. H., Brooklyn, N.Y.

Autos, He Says, Can't Take Their Alcohol Straight

IN ANSWER to the query by H.A.D., of Baltimore, Md., I would like to point out a few reasons why alcohol alone cannot be used as a motor fuel. Alcohol has a lower vapor pressure and a lower heat of combustion than gasoline, and if the combustion of alcohol is not complete, small quantities of acetic acid are formed, corroding the metal surfaces. In cold weather, the spark plugs often give trouble, because of the condensation of water. Recent tests performed in Germany show that gasoline alone gives 16.4 miles to the gallon, while alcohol alone gives fifteen miles and benzol twenty miles. One part of alcohol with one part of benzol gives 21.2 miles to the gallon, and two parts of alcohol with one part of benzol gives 20.3 miles.—R.A.H.K., Toronto, Canada.

Article About Flat Bow Lures Him Back to Archery

ALTHOUGH other activities have held my attention for some time, the article about the American flat bow, by Jack Hazzard, in a recent issue, was so good that it has dragged me back to my old interest in archery. The flat bow looks good, and I believe I'll make one. I would like to see Mr. Hazzard continue with a series on archery. There is plenty left to say on such subjects as arrow making, quivers, guards, nocks, and arrow plates, not to mention shooting instructions. Incidentally, I have been reading your fine magazine for longer than I can remember, and I have filed and indexed practically every issue as far back as 1928. The most interesting part of the whole magazine is, in my estimation, The Home Workshop section.—W.B.E., Mitchell, S.D.

Suggests Two Horns For Harmonious Honking

PERHAPS N.R.H., of Detroit, Mich., is justified in saying that road hogs pay little attention to his horn, but I know that most of us can hear automobile horns only too plainly. I have often thought that manufacturers should equip their cars with mellower horns or, at least, if they feel they need the loud horn, they might attach another, less raucous one. A low-toned, auxiliary horn would suffice in most cases, and it would certainly be restful for a change.—R.S., Flushing, N.Y.

Cannons To Right of Him, Cannons To Left of Him

DURING the long winter evenings, you can picture me as working away at the Gettysburg cannon model published in your latest issue. It just straddles my two hobbies, history and model making. And, while you're at it, why not give us a model of a naval gun of the War of 1812—the type used on the U.S.S. *Constitution?* I once saw such a model, mounted in a cross section of the ship's bulwark, with the hinged gun port, wheeled carriage, and block-and-tackle rigging. Such a model would be a fine ornament.—D.D.S., Annapolis, Md.

Wants Lightning Explained In Chemical Terms

AFTER reading about the ionization of water and the ability of ions to conduct electricity, in "Home Experiments With Water," in the September issue, I began to wonder if this slight ionization of water had anything to do with the path followed by lightning during a storm. In other words, does the electric discharge follow a path made by the more strongly ionized particles of water or moisture in the air? If the ionization of water has no effect upon the path of lightning, can a discharge alter atmospheric conditions so that rain would be precipitated from a saturated atmosphere immediately after a bolt passed through it?—T.D.Y., Sacramento, Calif.

Another Model Maker Would Invade Arms Field

AS A regular subscriber to your excellent magazine for several years, I'd like to suggest that, following your idea of publishing plans and instructions for building models of famous ships, you give us instructions for making models of historical pistols. To collect rare old pistols, such as the buccaneer flintlock, Saxon ball-butt, Wheelock, and Palmetto armory pistols would require a small fortune. I am sure that there are other collectors who would like to have such plans for model pistols.—H.W.W., Canonsburg, Pa.

Reader Reports Shortage Of Odds and Ends

AFTER reading your magazine for four years, I have only one fault to find with it. Every now and then, you publish some project that can be made with "a few odds and ends about the house." The authors of these articles must live in veritable junk yards; for my part, I can never scrape up all the "odds and ends" that are called for. Sometimes, the directions sound like these "scavenger parties" that have been popular lately, where the players have to dig up such out-of-the-way articles as wooden legs and side saddles. Why not help us out by publishing a list of junk yards in the principal cities of the country? You could call them "odds-and-ends supply houses."—R.W.H., Cleveland, Ohio.

DON'T GRUMBLE ABOUT RISING PRICES

Help Them

During last two years...Rent up 15%...Food up 37%...Clothes up 22%—WHY?

Why do prices go up?

Here's one reason everybody can understand. Taxes are added into your rent. They're a big slice of your gas and electric bill. Gasoline averages 40% taxes. 53 taxes go into a loaf of bread. Everything you buy is a tax collector. Therefore prices go up when taxes go up.

Government spending now equals almost ⅓ of our national income!

Many government expenses are worthwhile. But probably a third of what national, state and local governments spend is wasted. That's five billion dollars, $166.00 for each family in America. If we don't *do something,* where will the waste stop? Ten billions? Twenty billions?

Don't blame the landlord and the grocer for the high cost of living. It's your own fault. Only you can stop government waste and promote economical, efficient government. This is how to do it; *take these two steps now:*

1. Make this resolution: "I will support no candidate who cannot prove that he has used all his influence to reduce government expenditures."

2. Write three letters. One to your Mayor, or County Clerk, one to your Governor, one to the President. Say: *"I want the cost of government reduced,"* and sign your name.

There are forty millions of us, working to pay for local, state and federal government. It's up to us to insist that the government watch its expenses as carefully as we do ours. After all, it's our money the tax wasters are spending.

DO YOUR PART TO BRING BACK ECONOMY IN GOVERNMENT

Register . . . Vote . . . Replace the wasters with lawmakers who will SAVE public money.

Space for this message is provided by Popular Science Monthly
because of a firm conviction that a reduced cost of government is vital to the interests of all its readers.

POPULAR SCIENCE Monthly

OCTOBER 1936 VOL. 129 No. 4

RAYMOND J. BROWN, Editor

A part of the new All-American Canal, which will join the Colorado River with the Imperial Valley, California

DIGGING THE World's Biggest Ditch

MONSTER MACHINES ARE SCOOPING AN ARTIFICIAL RIVER BED ACROSS EIGHTY MILES OF BLAZING DESERT IN HUGE NEW IRRIGATION PROJECT

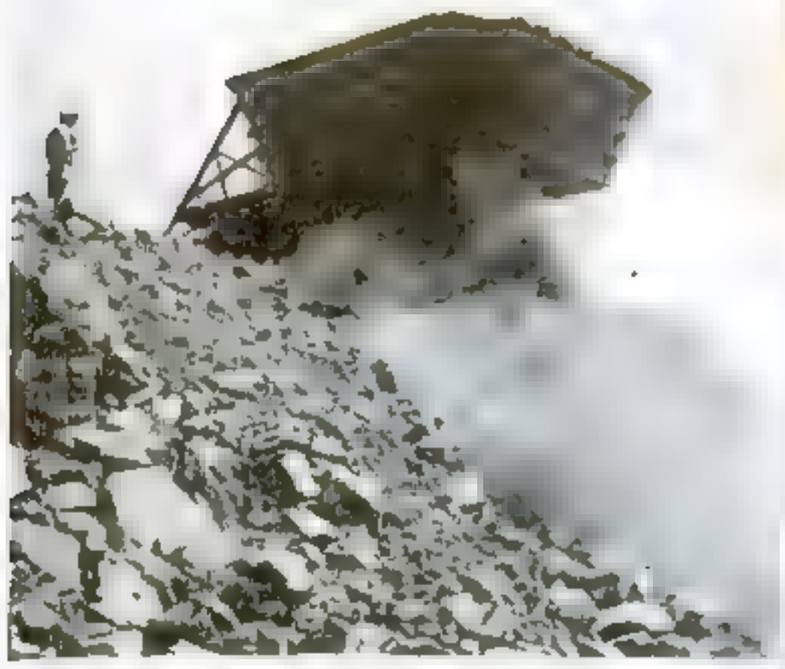
By Sterling Gleason

The big balloon tires on this tractor keep it from sinking into the sand as it pulls a "buggy" up a hill

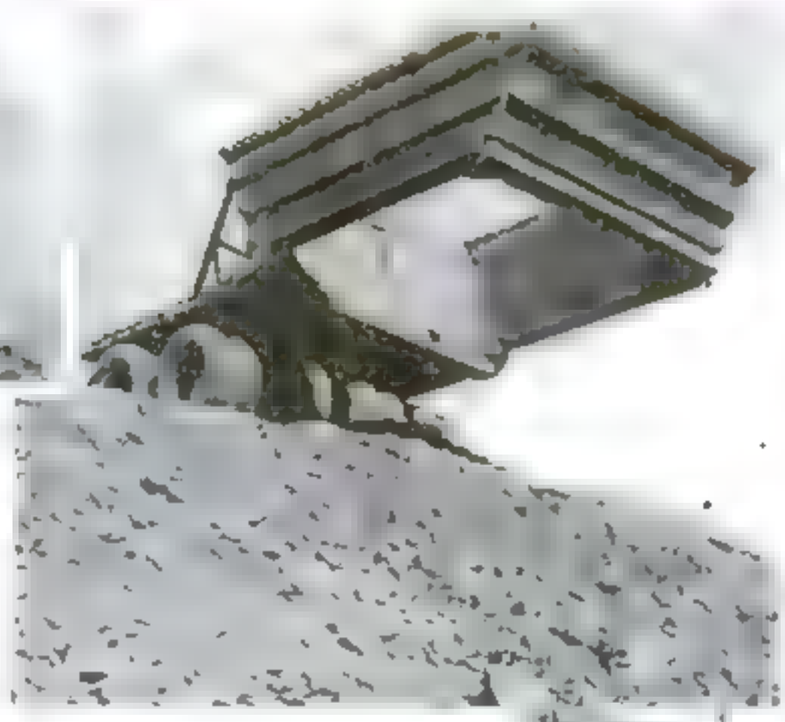
TO CREATE a brand-new river, wide, smooth-walled, and straight, stretching across eighty miles of blazing desert, is the huge project now being tackled by Uncle Sam's engineers. In the southwestern corner of the United States, a mechanized army of workmen is gashing the desert with a giant irrigation ditch, the largest ever built and last of the sensational projects designed to harness and tame the turbulent Colorado River.

Rushing through miles of sage and mesquite, plunging under natural watercourses through concrete siphons, the new All-American Canal will tap the Colorado's muddy waters about fifteen miles north of Yuma, Ariz. Laundering them clear in a giant washing machine, it will lead them due west across the

A steam shovel filling a small "buggy" with rock for lining walls of the canal



At the dumping place, the tractor driver pulls a lever and the body of the trailer slides back beyond the end of the floor



The empty "buggy" after its load has fallen through the open bottom onto the side walls of the canal

This is the big bucket of the drag-line, largest digger ever made. Shown here in the dumping position, it will hold an automobile

wind and water and shifting desert sands.

Long before a spadeful of earth was turned, the canal began to take form in models and drawings. Aerial photographers went aloft to sweep the country with their camera lenses. In an outdoor laboratory, experimenters made miniature canals, heaping up samples of materials, sprinkling, tamping them with rollers, and creating model embankments with varying degrees of slope. With instruments they gauged the density of the banks, measured the percolation when exposed to water, and learned exactly how steep the banks should be made.

But the most serious problem of all was that of crossing the valley of walking sand dunes—a Sahara-like waste of towering sand hills that slowly migrate under the influence of the wind. Reckless indeed seemed the engineers who dared to undertake the job, but careful observation of the dunes dispelled some of their terrors. The migration, though constant, was quite slow. A high embankment thrown up out of the material excavated from the canal would adequately guard against encroachment by the walking sand hills.

The engineers drew plans for a flat-floored ditch, half a city block wide at the water's surface, with V-shaped walls sloping back at a thirty-degree angle. Six feet above the water level is a "berm"—a flat roadway twenty feet wide. Another is located at the mesa floor on which the dunes march ceaselessly. Along these steps would move giant drag-lines, scooping out the channel below and building up the embankment above.

Ahead of the construction crews came surveyors and rodmen with transit and chain, staking out a path through the sagebrush and cactus. Behind them followed gangs of Indians, who cut away sands without crossing the Mexican border, as does the present Imperial Canal dug by farmers half a century ago. The main canal will empty into the irrigation network of Imperial Valley, where, under a broiling sun, a phenomenally rich soil puts forth amazing crops. Ultimately, a branch will snake northward to Coachella Valley, the fertile, palm-covered oasis from which come America's home-grown dates.

Nowhere has the job of moving dirt become so highly developed a science as here on this colossal project. The place swarms with strange machines that resemble gigantic bugs, waving their long, skeleton feelers, scuttling back and forth, carrying sticks or stones, or marching in antlike processions, laden with cargoes of earth. Each is designed to shorten hauling by ten feet here or fifty feet there; to cut lifting by inches; or to clip a second or two off the time required for handling.

A herd of mechanical mastodons such as never before assembled has been marshaled for this task. Huge, lumbering "buggies," rolling on balloon tires eight feet in diameter, haul and dump enormous loads. Diesel-powered bulldozers nudge wide steel blades ahead of them, leveling off the hilltops. Gigantic power shovels, with gaping maws of lightweight alloy steel, gulp tons of earth at a single bite.

Monster drag-line machines extend their long necks half a block at a stretch, scraping up each time enough sand to fill a truck. Mechanical hens lay whole nests of octagonal concrete piles, to be picked up like match sticks by powerful cranes and driven by machines to form foundations for the structures built on the silt of the river. Skyscraper concrete-mixing towers automatically weigh, mix, and pour materials to test-tube specifications. Cylindrical samples of cured concrete are crunched between giant jaws to detect variations from formula. Miniature canals, built in the laboratory, forecast the performance of the real canal under the action of

harsh brush with hooked, sharp instruments resembling medieval battle-axes. Tractors broke the virgin soil, loosening the earth and picking up heavy material. Where the surface was low, farmers drove four-horse teams pulling small "Fresnoes," or scrapers, to cut and fill. Nearly 1,000 horses were working at one time, and this phase of the work gave employment to hundreds of jobless men.

In their wake came the big machines. Steam shovels, Diesel tractors, and bulldozers puffed and snorted. Trucks by the hundred, piled high with excavated material, began to thunder over crude highways. Everywhere, dirt began to flow—load upon load, ton upon ton, streaming out of the steadily deepening cut being gouged out of the desert floor, and depositing itself upon the steadily growing embankments.

The long processions of trucks were joined by tractors pulling enormous "buggies," resembling toy wagons of the nursery but of Gargantuan size. Rolling on sixteen balloon tires taller than a man's head, these buggies carry their huge loads very near the ground, saving much lifting. When the desired spot is reached, the tractor driver pulls a lever and the side walls of the "buggy" slide backward, discharging the contents through the open bottom of the machine.

Dirt is spread by huge scrapers, attached to boxlike carts, which drop their blades and fill themselves as they move, then lift, carry, and dump, spreading their contents uniformly. One man does everything from his seat at the controls of the tractor which pulls the giant implement. Another simple but effective aid is the "tumblebug" scraper. Drawn by a tractor, it has a shoe on each side of its seven-foot blade, which enables the scraper to stand on its head, tumblebug fashion, dumping its contents instead of dragging to empty them. No helper is needed to turn the blade—it can be done by the tractor driver as he sits at his controls.

From the ancients, who built hard dirt roads by driving flocks of sheep over them to tamp them smooth and firm, the engineers learned a valuable lesson. Embankments now are compacted with a device called a "sheep's-foot tamper"—a huge roller studded with dozens of round "feet" several inches square. As it turns, each foot tramps the surface beneath it with a pressure of 250 pounds to the square inch. Tractors draw the bumpy rollers back and forth over the soft dirt until the impact of hundreds of mechanical feet has tamped it hard. Despite its spiky appearance, the tamper produces a much smoother surface than a solid roller.

No larger digging machine ever walked the earth than the monster drag-lines that scoop out the main contours of the canal. Twenty freight cars are required to carry the dismantled parts of one such machine. A 100-car train was needed to bring in the equipment used in digging a single thirty-mile stretch of canal.

One of the concrete-mixing towers where materials are proportioned and mixed

"Sheep's-foot tampers"—heavy rollers studded with iron "feet" that tramp the earth hard. They are drawn by tractors

A giant drag-line in action. When it moves from one location to another, it literally walks on two large eccentrically mounted shoes

Each drag-line controls a huge bucket traveling on cables at the end of a movable steel boom as high as a fifteen-story building. The cab itself is a veritable power house—a nest of seventeen different electric motors and generators, which operate fans, centrifuges, and pumps for keeping up the "circulation" and "breathing" of the giant organism. Heart and muscles are the two huge Diesel motors, the larger of them rated at 450 horsepower—half the strength of a crack Diesel locomotive. Lubricating oil and water both are cooled by special equipment to permit the motors to withstand the extreme desert heat. Special devices clean the *(Continued on page 124)*

Underground Fortresses

GUARD FRANCE FROM INVASION

Half buried in the ground at the end of a village street, this stout blockhouse connects with an underground fastness

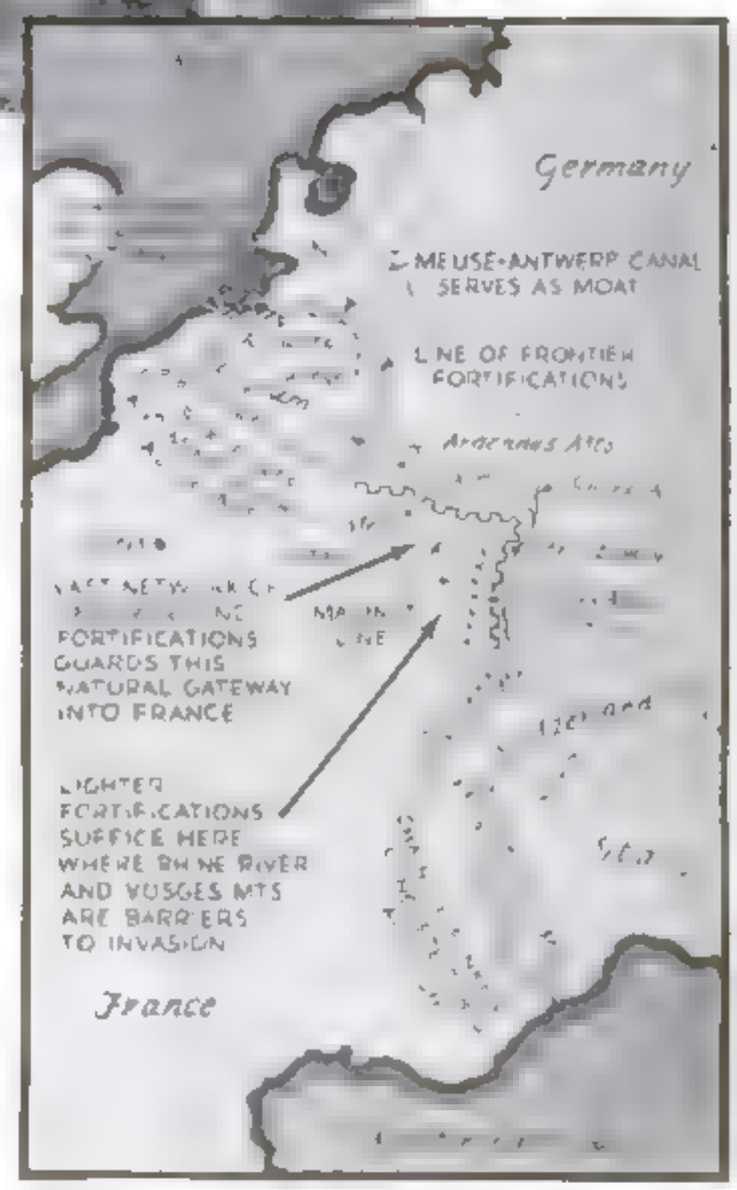
French soldiers on guard in one of the concrete machine-gun emplacements that form the outer fringe of the great Maginot Line

By THOMAS M. JOHNSON

INSPIRED by the same desperate fear from which sprang that wonder of the ancient world, the Great Wall of China, modern France is rushing to completion the most stupendous work of military engineering of our times.

However, beyond the threat of invasion that provides the reason for its existence, this chain of steel-and-concrete fortresses has little in common with the crude barrier of stone that was flung along the northern frontier of China more than 2,000 years ago. Instead of soaring into the air, its towers burrow downward, sometimes 300 feet into the earth. Around the summits of these subterranean citadels grow trees and grass, and peasants feed their flocks. You could walk across the Great Wall of France without knowing it—yet it is the most formidable fortress that man has ever created.

Actually, it is a vast series of underground fastnesses; subterranean tunnels, galleries, and chambers, lighted and heated by electricity; it is air-cooled, gasproofed, and equipped with every modern device to kill or maim those who attack it, and protect those who defend it. Together with the defenses that Belgium is building along her eastern frontier, this armored belt girds Europe from the Mediterranean to the North Sea. It has cost the thrifty French alone $350,000,000, and they are not through yet.



France's vulnerable eastern frontier, and the chain of defenses she is building to protect it

The interior of a heavy-gun casemate on the Maginot Line. A deep shaft leads downward to the galleries of the fort

At all costs, they are determined to prevent another invasion by the route that has been followed by attacking hordes three times within a little over a hundred years. Against that danger, they and the Belgians have called in science and invention to forge for them defensive armor so strong, so modern, that it will either scare off would-be invaders, or hurl them back.

If it does either of these things, this new Great Wall can preserve the peace of Europe. But will it? Statesmen, soldiers, engineers, millions of anxious men and women, would like to know the answer to that question. A burning question, these days since Hitler tore up the last shreds of the Treaty of Versailles, and marched his gray-clad battalions across the Rhineland, up to the gun muzzles peering from strange mushroom-shaped casemates that bar France's frontier.

That frontier presents something new in the science of fortifications. It is a practically continuous defense system, as nearly as possible impregnable, extending along the eastern frontiers of France and Belgium.

Most Formidable Defenses Created by Man Burrow Deep Down Into the Earth to Block A Historic Highway of Conquering Hordes

Its right flank is the southern portion facing Italy, Switzerland, and southern Germany. There the great engineer, nature, has provided ready-made defenses in the Alps, Jura, and Vosges mountains, and in the River Rhine. To supplement these, every pass and crossing is guarded by strong concrete forts, sunk in the earth, their apexes barely peeping above the ground. Farther back, upon carefully selected dominating heights, are permanent concrete emplacements for cannon.

By similar means, part of the left flank in Belgium can be defended. Mines are ready to explode and block the few roads of the wooded Ardennes mountains; sluices to release rivers like the Scheldt to overflow lowlands. But there are gaps.

In one, is the city of Liege. In 1914, the Germans amazed the world by quickly seizing its forts, with the bridges and tunnels at the Meuse. Now, bridges and tunnels are mined, there are more and better forts, and the new Meuse-Antwerp canal is a protecting moat, in turn protected by concrete forts.

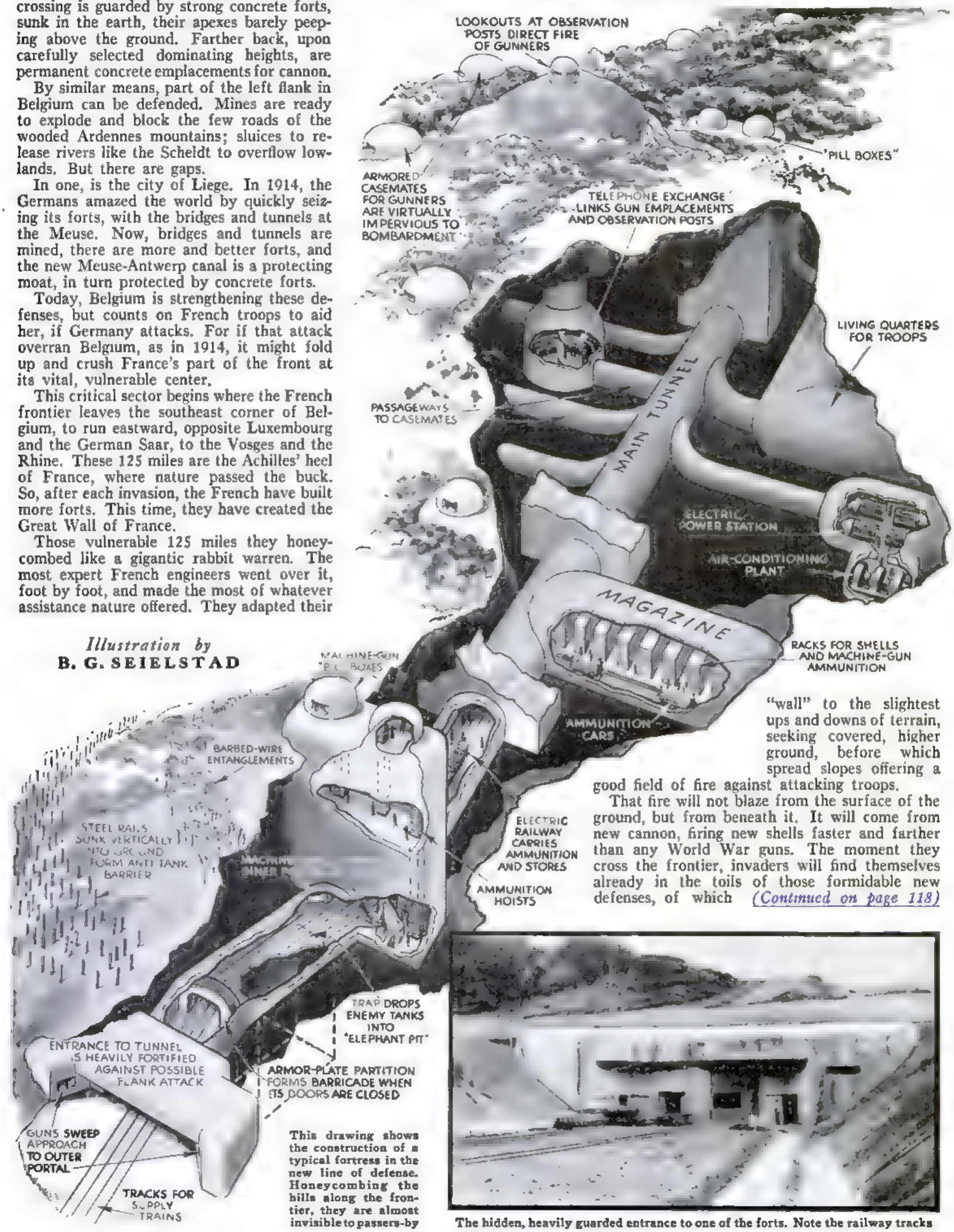
Today, Belgium is strengthening these defenses, but counts on French troops to aid her, if Germany attacks. For if that attack overran Belgium, as in 1914, it might fold up and crush France's part of the front at its vital, vulnerable center.

This critical sector begins where the French frontier leaves the southeast corner of Belgium, to run eastward, opposite Luxembourg and the German Saar, to the Vosges and the Rhine. These 125 miles are the Achilles' heel of France, where nature passed the buck. So, after each invasion, the French have built more forts. This time, they have created the Great Wall of France.

Those vulnerable 125 miles they honeycombed like a gigantic rabbit warren. The most expert French engineers went over it, foot by foot, and made the most of whatever assistance nature offered. They adapted their "wall" to the slightest ups and downs of terrain, seeking covered, higher ground, before which spread slopes offering a good field of fire against attacking troops.

That fire will not blaze from the surface of the ground, but from beneath it. It will come from new cannon, firing new shells faster and farther than any World War guns. The moment they cross the frontier, invaders will find themselves already in the toils of those formidable new defenses, of which *(Continued on page 118)*

Illustration by
B. G. SEIELSTAD



This drawing shows the construction of a typical fortress in the new line of defense. Honeycombing the hills along the frontier, they are almost invisible to passers-by

The hidden, heavily guarded entrance to one of the forts. Note the railway tracks

FOREST-FIRE FIGHTERS GET VOLUNTEER FIRST-AID CORPS

A forester using a portable short-wave radio transmitter to summon first-aid men from a dressing station set up by a corps of volunteer medical workers behind the fire lines

FORESTERS fighting fires in the wooded sections of California are now aided by a volunteer army of medical workers organized under the name of the California Forestry Medical Corps. Whenever men are called to beat back a forest blaze, word is rushed to the Corps' nearest headquarters, and a medical contingent speeds to the scene. If accidents occur at the fire front, portable short-wave radios flash word back to a dressing station set up behind the lines and first-aid men rush into the blazing area to administer emergency treatment and to bring back the burned and injured. Since its organization, the volunteer army has gone into the field and treated more than 4,800 fire fighters for burns and other injuries and has saved many lives.

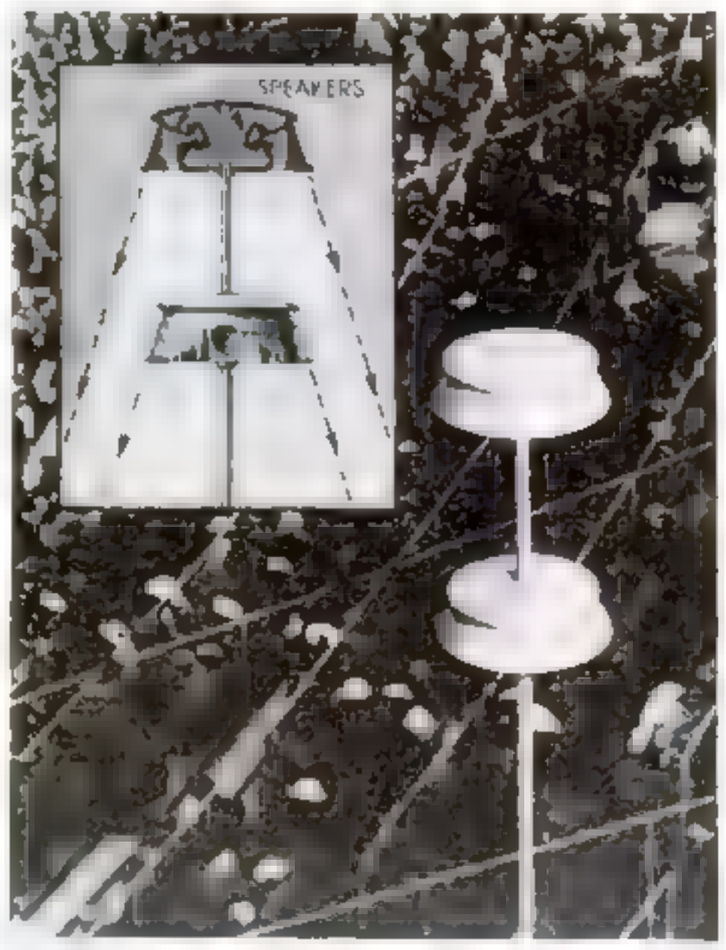
Removing a "black eye" the modern way, with static electricity, right, and infra-red rays, left

"BLACK EYES" TREATED WITH ELECTRICITY

"BLACK EYES," caused by swelling and discoloration following an eye injury, are treated with two unique electrical machines by a New York doctor. Static electricity given off by one machine, and warming infra-red rays emitted by the other, are applied to the affected area. The treatment is said to stimulate the injured spot, loosening the coagulated blood and causing the quick removal of congestion. With the apparatus, it is stated, all visible evidence of a badly bruised eye can be removed in about an hour.

NOVEL LOUDSPEAKERS ELIMINATE ECHOES

To REDUCE annoying echoes and overlapping sounds, a new outdoor public-address system recently tested utilizes novel umbrella-shaped deflectors that direct and control the sound waves from loudspeakers. Each unit consists of two overhanging decks supported by a central column. Five speakers, separated by insulating air spaces, are mounted in each deck. Directed by winglike deflectors, the sound waves from each speaker radiate downward to a specific section of the stadium or park, and then are reflected upward and out of the spectators' hearing range. Thus each part of the audience is served by a separate loudspeaker, and echoes and overlapping sounds are practically eliminated.

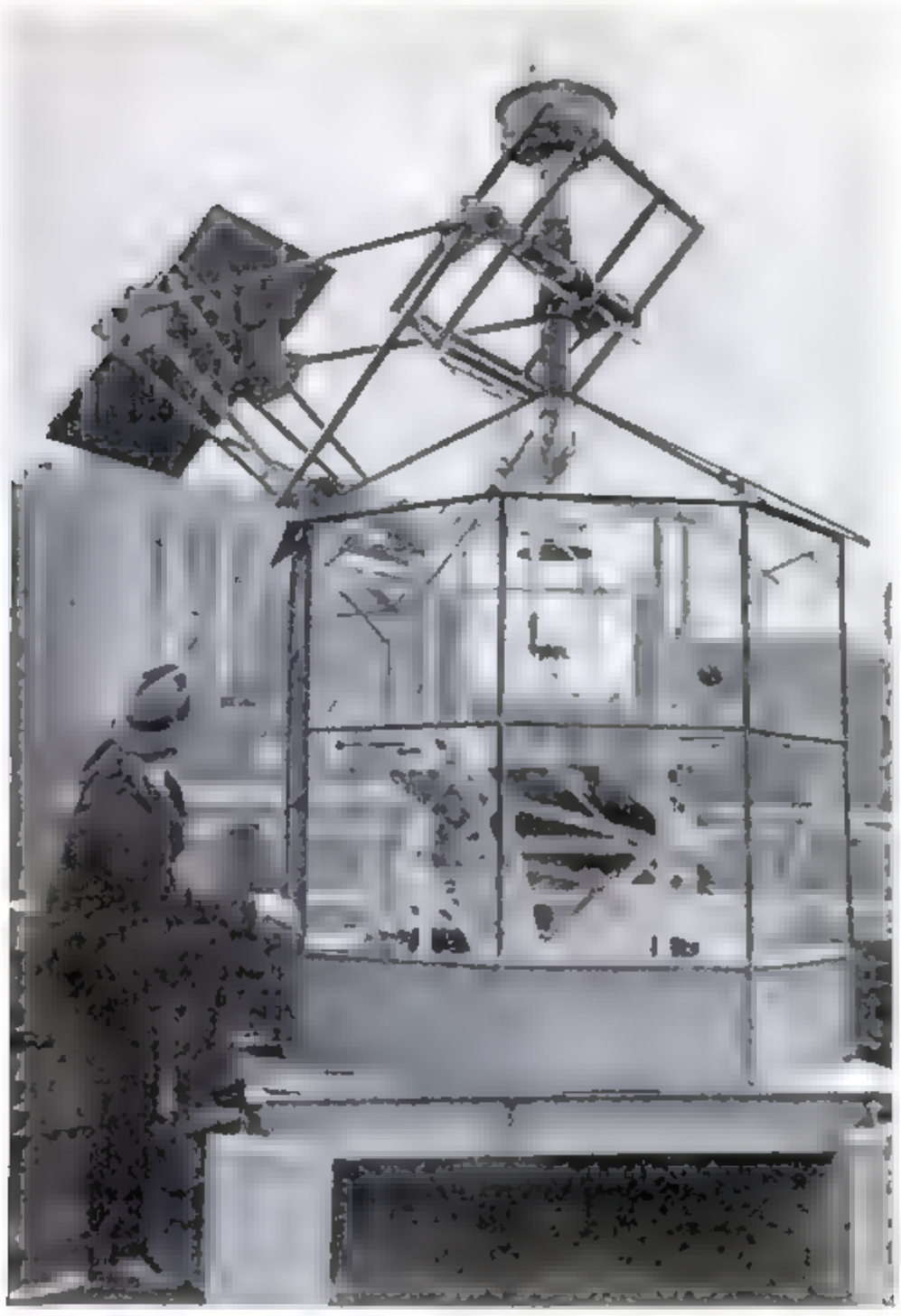


These "umbrella" speakers reduce echoes by directing the sound downward as in the diagram

HISTORIC BOTTLE HOLDS FAMOUS SOUP

A HISTORIC bottle in the possession of a Philadelphia doctor holds the world's most famous soup. The seventy-five-year-old veal bouillon is a part of the original batch used as a culture medium by Louis Pasteur, celebrated French chemist, to prove that germs floated everywhere in the air—and did not, as then supposed, generate in matter not exposed to the air. His discoveries explained the mysterious infections that so often followed surgical operations of his day, when wounds, surgical instruments, and bandages were commonly left unshielded from air-borne germs.

MIRRORS PIPE SUN TO SHADED WINDOWS



Sunlight, caught by a rotating mirror in the cage, is reflected down over the side of the building as indicated by the inventor

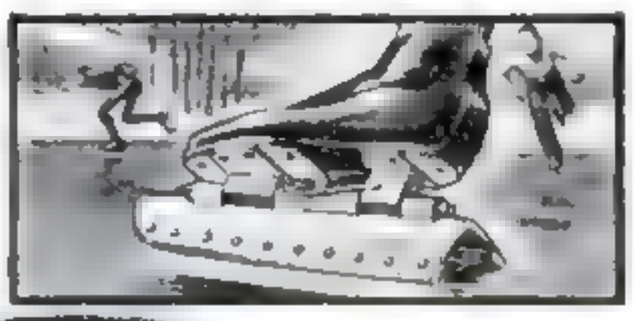
OFFICES, apartments, and hotel rooms in inner courts or lower floors of tall buildings are often cut off from direct sunlight for a large part of the day. To remedy this condition, Jacques Arthuys, a French inventor, has devised a unique reflecting apparatus to relay sunlight from a building roof into dull rooms. A large roof-top mirror, rotated electrically so that it continually faces the sun, reflects light rays through a series of stationary mirrors to a large reflector projecting over the roof edge. From here the rays travel vertically downward and are finally deflected into a room from a mirror just outside the window. The apparatus is put into action automatically, every sunny morning, when the rays of the rising sun heat and expand a gas in a sealed copper tube, causing it to actuate a mercury switch that starts the motor of the rotating mechanism. A model is already in use on a building in New York City.

SPORTS EVENTS FILMED BY CAMERA IN BALLOON

BY SUSPENDING a movie camera from a captive balloon, a German inventor makes aerial motion pictures of sporting events. Tried out at the recent Olympic Games in Berlin, Germany, the camera was mounted lens downward in a gondola framework beneath a small balloon. The latter was then tethered over the stadium at a height which enabled the camera to photograph the entire arena. Operation of the camera is controlled electrically from the ground through trailing wire cables. The system is expected to prove effective in filming pageants and outdoor activities other than sporting events.

DOUBLE-EDGED SKATE PIVOTS ON SHOE

ICE SKATES of radical new design, having double-edged runners and a special pivot mounting, are said to reduce ankle strain and permit high-speed turns without danger of slipping. Made from a rectangular strip of steel, the runner is bent to form two gliding edges. The center ridge is hinged on a pivot to a metal plate on the sole of the skating shoe, to allow the foot, instead of the skate, to be tilted when making turns.



Skate with double runner, shown at left, makes sharp turns with safety

RUBBER HOUSING MAKES SILENT SHAFT BEARING

MADE of solid rubber, a new housing for ball-bearing shaft units is said to cushion shocks and thereby reduce the noise and vibration common to conventional cast-iron housings. The bearing itself is pressed into the housing and locked in place with a rubber washer and thrust collar. A special lacquer coating preserves the surface of the rubber from deterioration.

"VIBRO-HARP" IS PLAYED LIKE A PIANO

CALLED a "vibro-harp," an odd musical instrument recently demonstrated before musicians in Chicago, Ill., looks like a small piano but has a tonal quality resembling that of a harp. Although its keyboard is considerably shorter, the instrument is played in the same manner as a piano. Actuated by the keys, ball-shaped mallets strike strips of metal, which are graduated in length to produce the correct vibrations for each note in the scale.

Piano keys on this odd instrument actuate bell-shaped mallets and vibrate strips of metal to produce tones that resemble those of a harp

SEAGOING MOVIE STUDIO GETS FOREIGN SCENES FOR AMERICAN FILMS

J. L. Shackelford and an assistant filming a scene in Egypt. Left, the *Athene* under sail in the Red Sea on her round-the-world picture hunt

RECENTLY returned from a globe-girdling photographic expedition aboard the yatch *Athene,* James L. Shackelford, prominent explorer and photographer, brought back 65,000 feet of movie film bearing typical scenes taken in twelve countries of Asia, Africa, and Europe. So that "retakes" could be made if necessary, film was developed daily in a unique cabin laboratory aboard the yacht. Tanks of developing chemicals, installed in the cramped quarters, were kept at constant, cool temperatures by a thermostatically controlled refrigeration unit. Felt pads, eight inches thick, surrounded the tanks to protect them from the extremes of cold and heat. Film sequences will provide artificial backgrounds for scenes taken in American studios.

In this temperature-controlled laboratory over 65,000 feet of film were developed

TRUCK GIVES GAS-MASK TRAINING

TO AID in training civilians in the use of gas masks, a mobile gas chamber mounted on a truck chassis has just been put into service in England. Before persons enter the air-tight chamber, chemicals are released from tanks to form a harmless vapor cloud which resembles poison gas. The unit will tour the country to give citizens practical experience in wearing masks under war conditions.

British policemen trying out the mobile gas chamber used for teaching civilians how to use gas masks. A harmless vapor released inside the air-tight truck body simulates poisonous fumes

INFLUENZA GERMS KILLED BY ULTRA-VIOLET LIGHT

INFLUENZA GERMS die when exposed to ultra-violet light, according to Harvard University scientists. In recent tests, air containing the germs was blown from sterile glass tanks into a chamber bathed in strong ultra-violet light. Ferrets which breathed the original germ-laden air contracted influenza, while those which breathed the light-treated air remained well. In the photograph above, the germ-laden air is being admitted to the chamber in preparation for the test.

Giant Model of City Used in Tests of Wind's Effect on Buildings

SO THAT scientists may study the effects of wind pressure on buildings, an accurate model of part of the city of London has been constructed at the National Physical Laboratory in England. About ten feet square, the reproduction represents a large area covering many famous London locations. Information obtained after extensive wind-tunnel tests of the model have been completed, will be made available to architects, builders, and city planning commissions for their guidance in erecting new buildings or strengthening existing structures.

Putting the finishing touches on the model of a section of London to be used in wind-tunnel tests

SHIP LIVE FISH IN SPECIAL TANK CARS

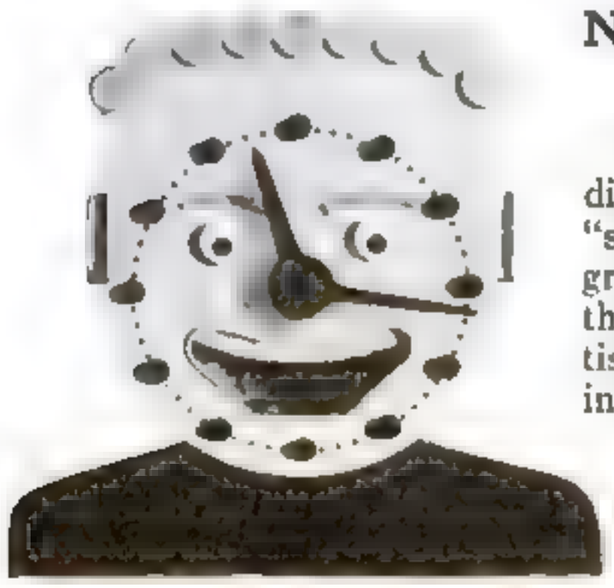
TO INSURE absolute freshness, fish are now being shipped to market alive in special railroad cars just placed in service. Accommodating more than seven tons of fish, each car is equipped with nine tanks, ten feet long, forty inches square, and with an individual water capacity of 700 gallons. Air pumps driven by electric motors constantly aerate and clean the water throughout the trip from seaports to inland markets.

Unloading live fish from the tanks in one of the special railroad cars recently put into service

LIBRARY LENDS PLAYTHINGS

CHILDREN'S playthings are loaned like books from a novel "Toy Loan Library" now in operation in Los Angeles, Calif. Used and broken toys contributed to the library are cleaned and repaired, and then loaned to poor children. Each toy is thoroughly sterilized when returned.

A small boy borrowing a scooter from the "toy library." Each plaything is thoroughly sterilized when returned



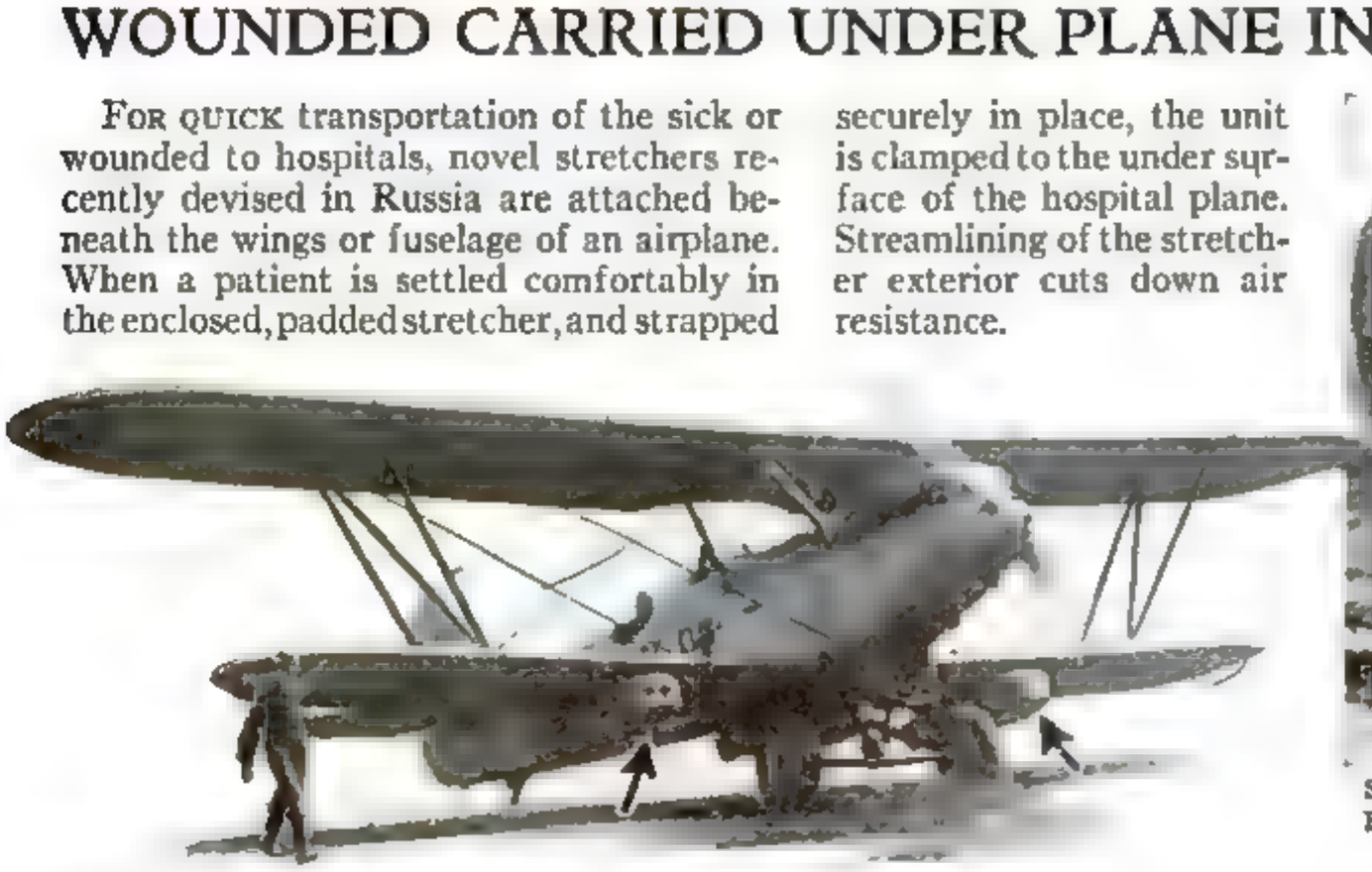
NOVEL TALKING CLOCK "TELLS" THE TIME

WITH A comic cartoon face as a dial, a talking clock recently invented "speaks" the quarter hours through its grinning mouth. Electrically operated, the device was designed as an advertising medium for use in railroad terminals, stores, and other public places.

The clock also can be used to announce trains, play recorded music, or give advertising talks between its time announcements.

WOUNDED CARRIED UNDER PLANE IN STREAMLINE STRETCHERS

FOR QUICK transportation of the sick or wounded to hospitals, novel stretchers recently devised in Russia are attached beneath the wings or fuselage of an airplane. When a patient is settled comfortably in the enclosed, padded stretcher, and strapped securely in place, the unit is clamped to the under surface of the hospital plane. Streamlining of the stretcher exterior cuts down air resistance.



Strapped into streamline stretchers, as above, sick and wounded can be carried under the wings and fuselage of any airplane, as at left

A typical scene at a muzzle-loading-rifleshoot. This photograph, with the others on these pages, was taken at a contest staged by the Canal Fulton Gun Club, Canal Fulton, Ohio

Modern Daniel Boones

J. Gesaman, eighty-year-old gunsmith, shooting a muzzle-loader he made by rebuilding an old .22 caliber rifle

LEARN MARKSMANSHIP WITH MUZZLE-LOADERS

GRANDFATHER'S muzzle-loading rifle, whose barrel has made a home for a family of spiders during a good many years, is in the limelight once more. This comeback of the old-time flintlock and percussion-cap guns has taken place during the past half dozen years, as a result of a widespread revival of interest in muzzle-loading rifle shooting throughout the country.

There are scores of gun clubs in the United States in which members shoot nothing but muzzle-loading firearms. There is a National Muzzle-Loading Rifle Association, with headquarters at Portsmouth, Ohio, and a membership already above 500. There are thousands of individual gun enthusiasts who have found pleasure

Steps in loading a slug gun: First, a patch is used to swab the bore

Then, the powder is poured into the muzzle from a horn or flask

The false muzzle in place, with the paper patch used for wadding

The bullet is now inserted in the false muzzle on top of the paper

Historic Weapons Bang Again As Gun Lovers Find Thrills In Shooting Old Flintlocks And Percussion-Cap Rifles

By

WALTER E. BURTON

in the muzzle-loader. Many of these fans use their old-time weapons to hunt woodchucks and other game, as well as for punching holes in paper targets.

Seven years ago, it was almost impossible to find an old-time rifle in working order, at least anywhere except in the vicinity of Canal Fulton, Ohio, where the first of the present-day muzzle-loading rifle clubs was then planning its initial annual shoot. Today, it is next to impossible to find an old-time rifle that has *not* been put in shooting order, for gun enthusiasts have unearthed every available firearm, regardless of its condition, and put it in shape for contest shooting.

They have found that there is a lot of romance and fascination connected with the use of firearms of a type that figured so prominently in carving this nation from a wilderness. Often, the individual gun has a historical background of its own. A great many gun addicts find pleasure in rebuilding their pieces, tinkering with the actions, making bullet molds, and casting balls and slugs for their muzzle-loaders.

The reconditioning of ancient firearms has grown into a flourishing business among gunsmiths, particularly with the old-timers who, in their youth, worked with the same kinds of arms. The amount of effort necessary to restore a rifle to working order depends on the care the gun has received during its long retirement. Sometimes only a general cleaning-up is needed. More often, the barrel has to be rebored and rerifled. Not infrequently, the entire gun has to be rebuilt, with a new mainspring, new stock, new nipple, and even a new barrel. Sometimes, all that remains of an old gun is the barrel and action, so that a new stock has to be made; or maybe only a single part is usable, and so a number of gun

A thirty-pound rifle being fired from a bench rest. This gun shoots a .44 caliber slug, and is said to be remarkably accurate at 220 yards even though it is more than fifty years old

A HYBRID AMONG MUZZLE-LOADERS

Made out of parts of three different guns, this rifle is loaded with a blank cartridge at the breech as a powder chamber, and a bullet at the muzzle. Right, scoring shots by adding the distances of bullet holes from center of target. The shortest "string" wins

With a short tool, the bullet is rammed down into the muzzle

With the bullet half protruding, excess paper is torn away from it

Then, the long ramrod is employed to drive the bullet down the gun barrel

BEAR'S-EYE VIEW

Looking into the business end of a large-caliber flintlock owned by H. W. Porter, of Akron, Ohio. The "pfffft-bangs" are fun to shoot—if it isn't too damp for the powder

remnants have to be combined to form a complete piece.

Within the last year or so, there has developed a demand for new muzzle-loaders. This is partly because the supply of old guns available for actual use is being exhausted. And so gunsmiths are turning out handmade weapons, much as they were made a century ago. Amateur gunsmiths, too, are finding much fun in making their own muzzle-loading rifles. This work, they find, is not difficult, but requires a lot of patience and care. Barrels and other parts of modern rifles frequently provide material for new muzzle-loaders. Some shooters, in order to qualify for competition in muzzle-loading matches, have even rebuilt breechloaders into muzzle-loaders. Obsolete military rifles frequently are converted in this way. In addition to working on the guns themselves, muzzle-loading gun addicts find it a pleasure—as well as a necessity—to make their own powderhorns, shot pouches, ramrods and other auxiliary equipment. The art of molding bullets is being revived in many corners of the land.

Muzzle-loading rifles being used in present-day matches include flintlocks firing lead balls, percussion rifles firing balls, and percussion slug guns firing elongated slugs or bullets. The ball rifles employ cloth patches to enable the balls to grip the rifling of the barrels. Slug guns use bullets designed so that the pressure of the explosion expands the soft-lead base into the grooves of the rifling. Slug rifles are considered more accurate than ball guns because their bullets are ballistically more perfect, and because of the positive grip between the slug and the rifling.

The accompanying photographs show some of the activities at a typical muzzle-loading-rifle shoot recently held at Canal Fulton, Ohio, by the Canal Fulton Gun Club, one of the oldest muzzle-loading clubs in the country. This shoot brought out an amazing assortment of old-time rifles, as well as a great many modern conversion jobs and new guns. There was a Union sniper's rifle that had been used during the Civil War; several showy pieces, with curly-maple stocks and fancy German-silver inlays and trigger guards; a number of guns whose barrels were made by such famous gunsmiths as Brockway, Lehman, and Harry Pope, and an assortment of small squirrel rifles, offhand guns, and hybrids combining parts of several pieces.

To the person accustomed to handling a .22 caliber rifle, some of the old-time weapons are amazing in their proportions. Some of the slug guns weigh nearly fifty pounds, which is the weight limit placed on rifles in the Canal Fulton shoot. Their barrels look like those of small cannon, being more than two inches in diameter and having a bore almost three quarters of an inch between opposite lands, or projecting surfaces that form the rifling. The smallest guns shoot bullets of about .25 caliber size, while the largest may be rated at .75 caliber. Some of the biggest bullets weigh nearly two ounces.

Shooting takes place, in muzzle-loading-rifle matches, from three positions. Some matches are for offhand shooting, in which the contestant uses a lightweight rifle and fires from the shoulder while standing. The heavier rifles are fired either from a prone position, in which the shooter lies on the ground and rests the muzzle on a support of some kind, or from a bench, in which position the rifleman rests the muzzle of the gun on a bench resembling a sawhorse, and himself sits on a stool at its side. In a typical competitive shoot, there will be matches for ball rifles at fifty yards, offhand position; at fifty yards with ball guns, from prone position or bench rest; at 100 yards prone or bench, with ball or slug rifles, and at 220 yards under the same conditions; contests at various ranges for women shooters only, and perhaps a competition between the "pfffft-bang" flintlocks.

The supporters of the old-time precision rifles maintain that, at short range, their guns will shoot every bit as accurately as any modern target or sporting rifle ever made—and they support their claims by exhibiting targets with single holes in the ten-rings, made by five or ten slugs striking the same spot at 100 yards. Muzzle-loading fans believe that the new sport is of real military value, because it will train thousands of persons to shoot, who otherwise might never learn to hit the well-known "side of a barn."

The flintlock pictured at the left has its hammer at the half-cock position. The powderhorn and shot pouch are examples of the craftsmanship of modern Daniel Boones

You need plenty of elbow room to load an old-time weapon like the percussion gun seen below

Below, Clyde Dixon, of Marion, Ohio, firing "prone" with a .48 caliber rifle made in 1878. Right, a target with five shots in it (four in the center hole) made at fifty yards range

TESTS EXPLAIN MYSTERY OF

"Whispering Galleries"

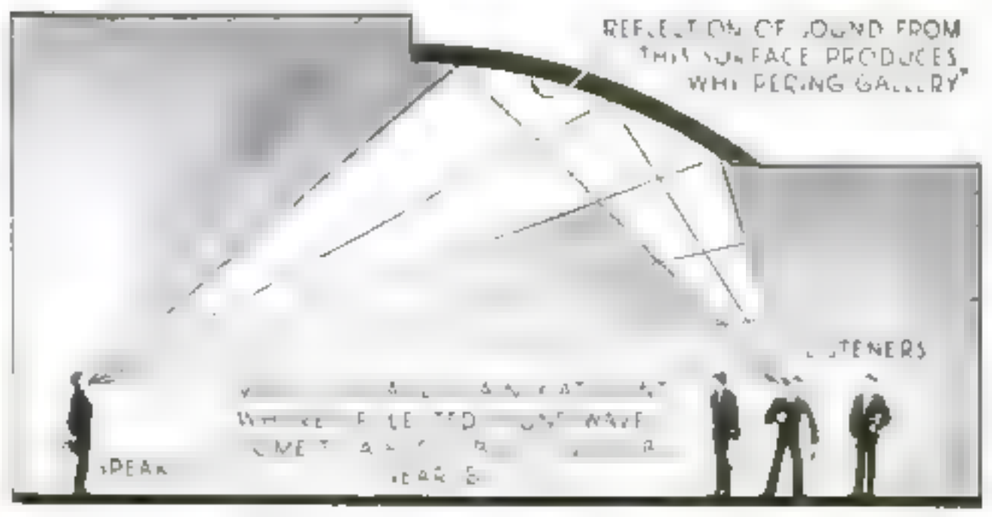
A "WHISPERING GALLERY" in the United States Capitol has just yielded its last secret to scientists. Guides have long pointed out to tourists a spot in the building's Statuary Hall where they can plainly hear words spoken in the lowest of tones at the opposite side of the large room. The story is told that the presiding officer of the House of Representatives, when that body formerly met in this hall, took advantage of the odd phenomenon to communicate privately with members seated thirty or forty feet away. Experts who investigated the effect pronounced it due to a peculiar echo from the dome. Now Richard L. Feldman, physics instructor at a Washington, D. C., high school, has located the exact place where the echo originates. For tools he used a high-pitched whistle and a stethoscope, each mounted in the bulb socket of an automobile headlamp reflector. By projecting the sound of the whistle at the dome, and picking up the echo of the shrill tone with the stethoscope, he found the source of the "sound mirage" to be an area slightly to the right of the roof arch and almost directly above a brass plate that marks the spot where John Quincy Adams died in 1848.

"Whispering galleries" like that of the Capitol exist in many parts of the world. St. Paul's Cathedral, in London, England, contains a circular passageway near the dome where a whisper may be heard from one end to the other. Italy has another celebrated example in the grotto known as the "ear of Dionysius" at Syracuse, in Sicily. Here the rustle of a piece of tissue paper may be heard 200 feet away. Legend has it that Dionysius the Elder, tyrant of the ancient city of Syracuse, spied on prisoners confined in the S-shaped cavern from a small room near the roof, and could overhear their softest spoken words without revealing himself.

R. L. Feldman and an assistant testing the home-made apparatus used to solve the riddle of the "whispering gallery" in the national Capitol

The Ear of Dionysius, a natural "whispering gallery" formed by a grotto at Syracuse, Italy

Explaining these weird effects, scientists point out that sound waves can be reflected, refracted, and brought to a focus exactly like light waves. A miniature "whispering gallery" can be produced in a laboratory by placing a watch at the focus of a large parabolic mirror of metal or plaster, which projects a beam of sound exactly as a searchlight does a beam of light. If a second parabolic mirror is placed in the path of the sound beam fifty feet or so away, an observer placing his ear at the focus can hear the ticking of the watch. A similar effect is produced by accidental combinations of wall surfaces that bring sounds to a focus at a considerable distance from the source, yielding a "whispering gallery" on a large scale.



A brass marker in the floor of the Statuary Hall in the Capitol building at Washington, D. C., indicates the approximate spot where listeners must stand to obtain the echo effect produced by the dome, as shown in the diagram above

THE MERCY SHIP OF UNCLE SAM'S FLEET

The U S S. *Relief* at anchor in Los Angeles Harbor. The first vessel to be specially constructed for use as a floating hospital with the U.S. Navy, she is equipped with all modern medical appliances. Below is a scene in the up-to-date operating room on the *Relief*

IN THE CRADLE OF THE DEEP. Patients in one of the surgical wards aboard the *Relief*. Without crowding, the ship can accommodate 360 sick and injured, while as many as 500 can be cared for in an emergency. Her personnel includes sixteen Navy physicians prepared to minister to any ailment among the 45,000 men behind the guns of the fleet

MIRACLES OF Surgery at Sea

PERFORMED IN NAVY'S FLOATING HOSPITAL

FORTY miles off the southern California coast, the U. S. S. *Oklahoma*, one of Uncle Sam's dreadnoughts, wallowed through a heavy sea, firing short-range battle practice. In No. 1 Turret, the crew went about its business of loading and making the fourteen-inch rifles ready to fire with the precision of a fine watch.

Suddenly, the gun captain doubled over in pain. A hurried consultation by the two ship's doctors brought a quick diagnosis: perforated peptic ulcer. This, they knew, required immediate operation, for with each hour the man's chances of life were reduced by half.

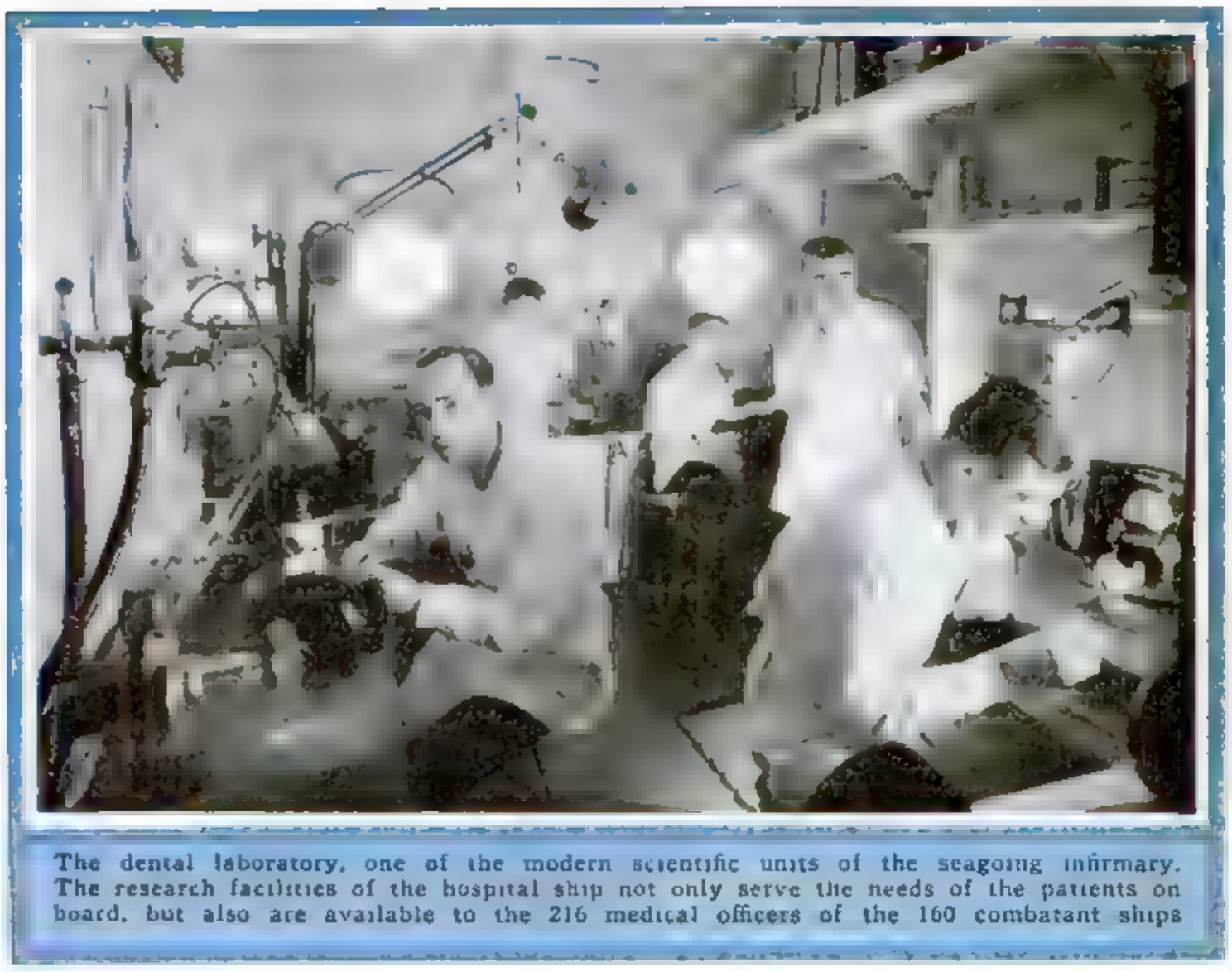
A radio message flashed to the U. S. S. *Relief*, the Navy's floating hospital, then riding at anchor within Los Angeles Harbor. Surgeons hurriedly prepared to operate. Meanwhile, eased by opiates, the man was bundled into a scouting plane. The pilot raised his hand, compressed air shot the plane into the sky, and off it went in a race against death.

Within a half hour the plane glided down to a landing and taxied alongside the *Relief*. Trained Hospital Corps men lifted the suffering petty officer into a stretcher and carried him to the operating room. Again, with the speed and skill acquired in performing thousands of emergency operations, four surgeons worked against time. Scarcely an hour after he

A Sleek, White Mercy Vessel Follows the Fighting Ships Of Uncle Sam's Battle Fleet With Modern Medical Care For the Men Behind the Guns

• • •

By ANDREW R. BOONE



The dental laboratory, one of the modern scientific units of the seagoing infirmary. The research facilities of the hospital ship not only serve the needs of the patients on board, but also are available to the 216 medical officers of the 160 combatant ships

had first complained of illness, the man lay in a comfortable bunk in the surgical ward, out of danger and ready to start the climb to complete recovery.

Only an incident in the day's work of naval surgeons, this case reveals how, aboard the *Relief* and the larger ships of the fleet, they daily meet emergencies with feats of medicine and surgery which are little known to the world at large.

On the *Relief*, the only floating hospital now attached to the American Navy, a corps of experts ministers to the health of the Battle Force, keeping officers and men fit to fight. Theirs is a little-known tale of heroism. To them, many officers and men of the fleet owe their lives.

Aided by X rays, heat-treatment apparatus, complete medical and dental laboratories, and a fully equipped surgery, they can meet any emergency. Many times, delicate operations are performed at sea, with the doctors lashed by ropes to the operating table. The *Relief* can handle 300 cases in her surgical wards—more than the average hospital—without crowding.

But the *Relief* does not confine its activities to sickness and injuries at sea, nor always to humans. Recently, an injured seal flopped up onto the gangway. Doctors sewed up lacerations, applied dressings, and returned the seal to the sea. "I am informed," the chief surgeon told me, "the mammal came back for several days promptly at 8:45 a.m., for more dressings."

Today, the Navy provides the best possible medical attention for the officers and men of the fleet. At one time, a doctor was employed for service on each individual ship and was selected by the captain. He was paid $25 a month. Some time later, the ship's doctor was recognized as an officer and allowed to wear a uniform. In 1871, the medical department of the Navy was organized. Then medicine and surgery in the fleet came into its own, the function of the doctor being recognized as "the keeping of as many men at as many guns as many days as possible."

"In time of peace," Capt. Lucius W. Johnson, senior medical officer on the *Relief*, explained to me, "the work of a doctor on a naval ship may be compared to that of a physician practicing in a small town, except that all his patients are men, mostly between twenty and thirty years of age. The *(Continued on page 128)*

OFFICIAL PHOTOGRAPHS, U. S. NAVY

Navy Hospital Corps men bringing a patient alongside the *Relief* in a motor boat. At the right, an injured seaman, lashed securely to a stretcher, is being hoisted aboard the hospital ship for surgical care

Left, a corner of the X-ray laboratory on the *Relief*. In many emergency cases, this equipment has helped save lives

JET-PROPELLED FLOAT SPOUTS SPRAY TO FIGHT PIER FIRES FROM BELOW

TINY robot fire boats, small enough to go under waterfront piers, are proposed by a Seattle, Wash., inventor as a means of combating wharf blazes. A three-foot model recently demonstrated his scheme as 400 Pacific Coast fire chiefs looked on. The captive boat, trailing a hose that supplies it with water, is propelled by a small jet discharged sternward. A larger jet spurts aloft against the fire. Twin cables, manipulated by an operator on a distant craft, swivel the underwater nozzle to steer the midget fire boat. After the boat has accomplished its purpose, the water is shut off and the hose and cables are reeled in to retrieve it.

From the deck of a fire boat, the inventor guides his novel fire-fighting float toward a burning pier by means of two cables which direct the propelling underwater jet. Diagram shows how nozzle is controlled

GIANT PHONE IDENTIFIES PUBLIC BOOTH

FINDING a telephone is easy in Moscow, Russia, where public booths are plainly recognizable a block or more away. To identify its purpose, each kiosk is surmounted by a monster imitation of a telephone instrument, as shown in the illustration at the right. The lettering on the door indicates that the installation is a "telephone automat," or dial phone, of the coin-box type familiar in American cities. To operate the telephone, Moscow residents drop a ten-kopeck piece in the coin box and then dial the desired number.

RIFLE RANGE HAS ROLLING TARGETS

RIFLE enthusiasts are offered a new kind of target practice by a Framingham Center, Mass., inventor. The targets are clay "pigeons" of the type used in trapshooting, but instead of being projected through the air they roll edgewise before the marksman, one at a time, on an inclined bench or track eighteen yards away. The trap or release mechanism, which can be worked from the firing line by pull levers, employs magazines holding fifty targets apiece. When one magazine is emptied, it may instantly be replaced.

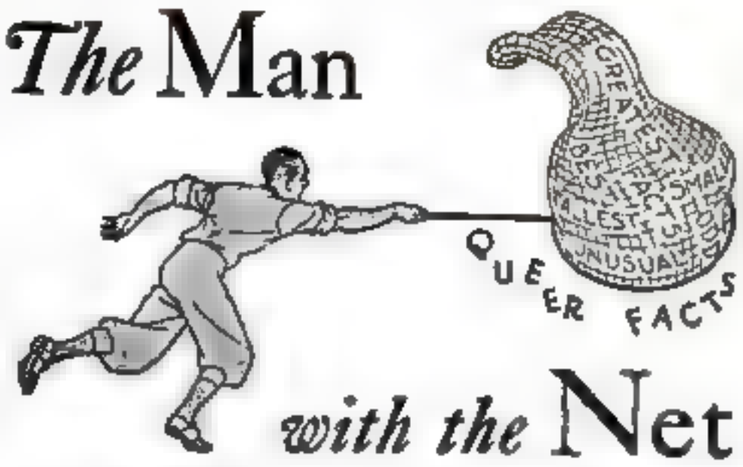
This shooting trap lets clay "pigeons" roll down an incline

At a range of eighteen yards, shooters try to hit the targets as they roll across a bench

AIR-CONDITIONS OFFICE WITH AUTO RADIATOR

TO KEEP comfortable during a recent heat wave, Harry R. Swanson, Secretary of State of Nebraska, connected an old auto radiator to a cold-water tap and turned on the faucet. The improvised air conditioner used 15,000 gallons of water a day, but it worked. With a fan behind it, the office could be kept as cool as desired.

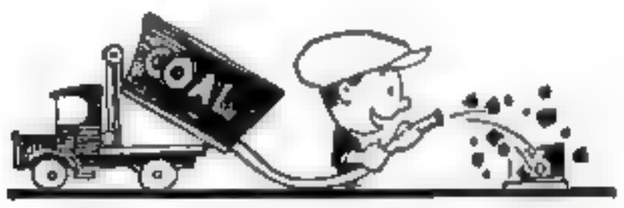
The Man *with the* Net



TEA LEAVES *are picked every seven or eight days from the same shrubs.*

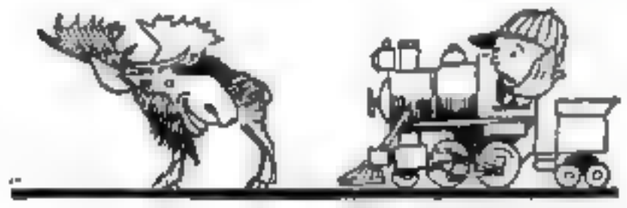
WHISTLING ARROWS *served early imperial Chinese bodyguards in much the same manner that sirens are used by motor-cycle police escorts today.*

RUBBER COAL CHUTES, *designed to reduce noise, have been invented by a Connecticut farmer.*



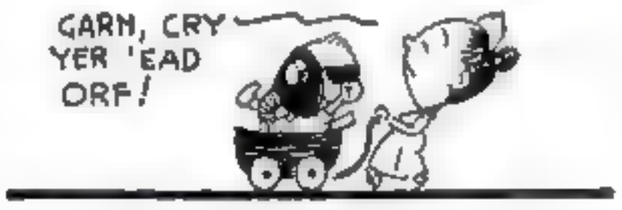
SMALLEST *cud-chewing animal in the world is the dik-dik, an African antelope no larger than a rabbit.*

MOOSE *have the right of way over trains on the tracks of an Alaskan railway.*



SHOES *are tighter some days than others. Tests show that a D-width shoe may shrink to a B width when going from dry to moist atmospheric conditions.*

BABY BUGGIES *equipped with gas masks have been designed in England for protection during air raids.*



SPONTANEOUS COMBUSTION *destroys one out of every ten tons of hay produced on American farms.*

GLUE *has been used for at least thirty centuries in China.*

OCEAN WATER *off western Cuba is a foot higher than that at the eastern tip. The Gulf Stream, piling water against the coast, is responsible for the difference.*

JAPAN *has an average of 4,000 perceptible earthquakes a year.*

MUSICAL INSTRUMENT IS HYBRID

STRINGED and brass musical instruments are combined in the "cello-horn," a hybrid music maker exhibited recently at a trade convention in Chicago. As shown in the photograph at the right, it has the finger board of a cello, a body like that of a violin, and a curling brass horn with its bell at the bottom. Played like a cello, the unusual musical instrument is said to produce a unique tonal effect.

Played like a cello, this strange mixture of string and brass instruments has new tones

COLLECTS ODD PITCHERS AS NOVEL HOBBY

COLLECTING pitchers is the hobby of Mrs. Lue Stuart Wadsworth, of Newton, Mass., shown below with some of the 200 pitchers she has gathered from various parts of the world. Mrs. Wadsworth started her collection in 1912, and now numbers among her possessions pitchers from thirty-eight states and from twelve foreign countries. The pitchers are made of porcelain, of china, and of glass.

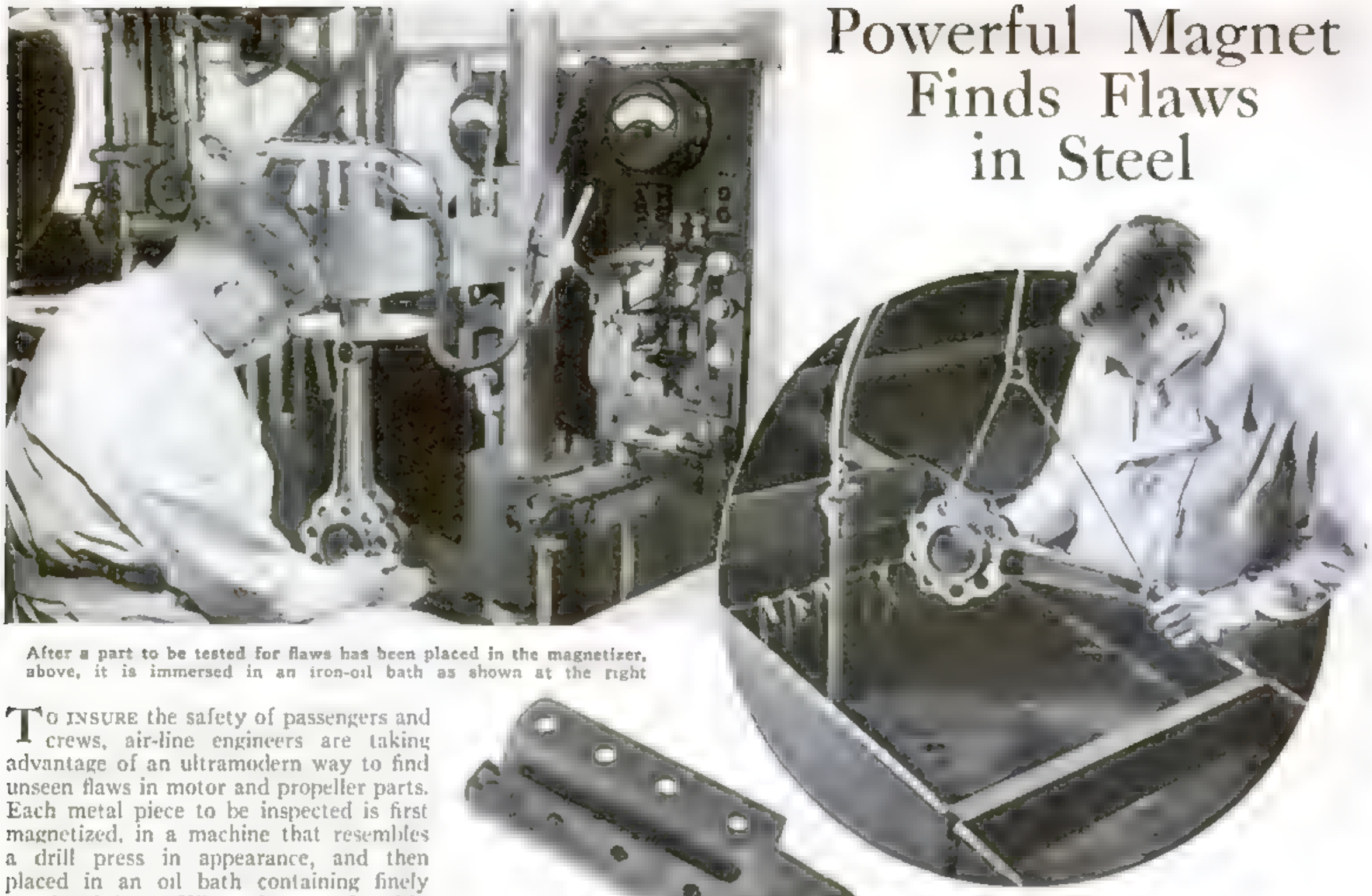
Mrs. Lue Stuart Wadsworth, of Newton, Mass., with a number of her 200 rare pitchers

TRAVELING BOX OFFICE SELLS MOVIE TICKETS

TO SERVE patrons who wish to buy tickets for a new motion-picture theater in Moscow, Russia, a traveling booking office on wheels sets up its shop on the principal thoroughfares of the city. The "box-office truck" drives around the city, stopping at street corners and so bringing movie tickets directly to the purchaser. It is shown here as it serves prospective customers on Sverdlovsk Square, in the center of Moscow. Huge posters on the side give the truck additional value as an advertising medium for new presentations.

Cruising through the thoroughfares of Moscow, Russia, this box office on wheels carries theater tickets to movie patrons. It also serves as an advertising billboard

Powerful Magnet Finds Flaws in Steel



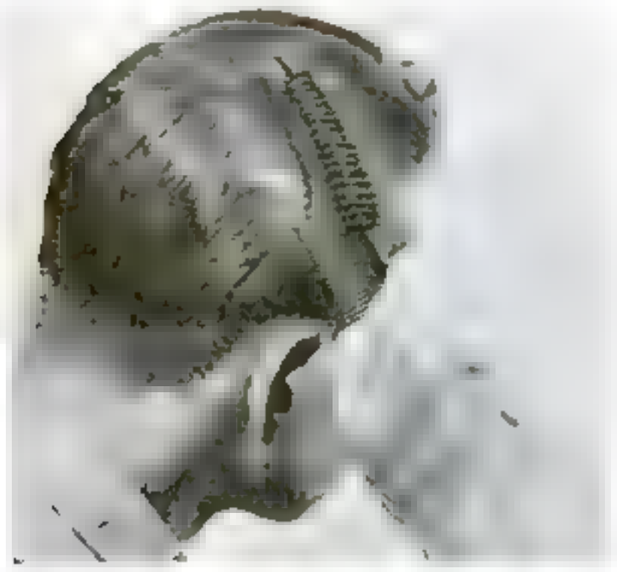
After a part to be tested for flaws has been placed in the magnetizer, above, it is immersed in an iron-oil bath as shown at the right

The visible line of iron dust on this test part indicates an internal defect

TO INSURE the safety of passengers and crews, air-line engineers are taking advantage of an ultramodern way to find unseen flaws in motor and propeller parts. Each metal piece to be inspected is first magnetized, in a machine that resembles a drill press in appearance, and then placed in an oil bath containing finely powdered iron. When the part is withdrawn, telltale black particles of iron plainly outline any break, adhering tenaciously to the surface of the metal at this point because they complete the magnetic path that is broken by the flaw. Surface cracks so fine as to be invisible under a 100-power microscope have thus been detected, it is said, and other cracks hidden as far as two inches within the solid metal have also been found. Where light-colored traces on a dark background are preferred, dry iron powder is substituted for the iron-oil bath and is dusted on with a hand shaker, the excess powder falling off when the piece is tapped or shaken. If an airplane part is found satisfactory, after inspection it is placed in a demagnetizing machine and restored to service. A leading air line that uses this method for periodical overhauls of motors reports it to be almost uncanny in its ability to detect imperfections in metal airplane parts.

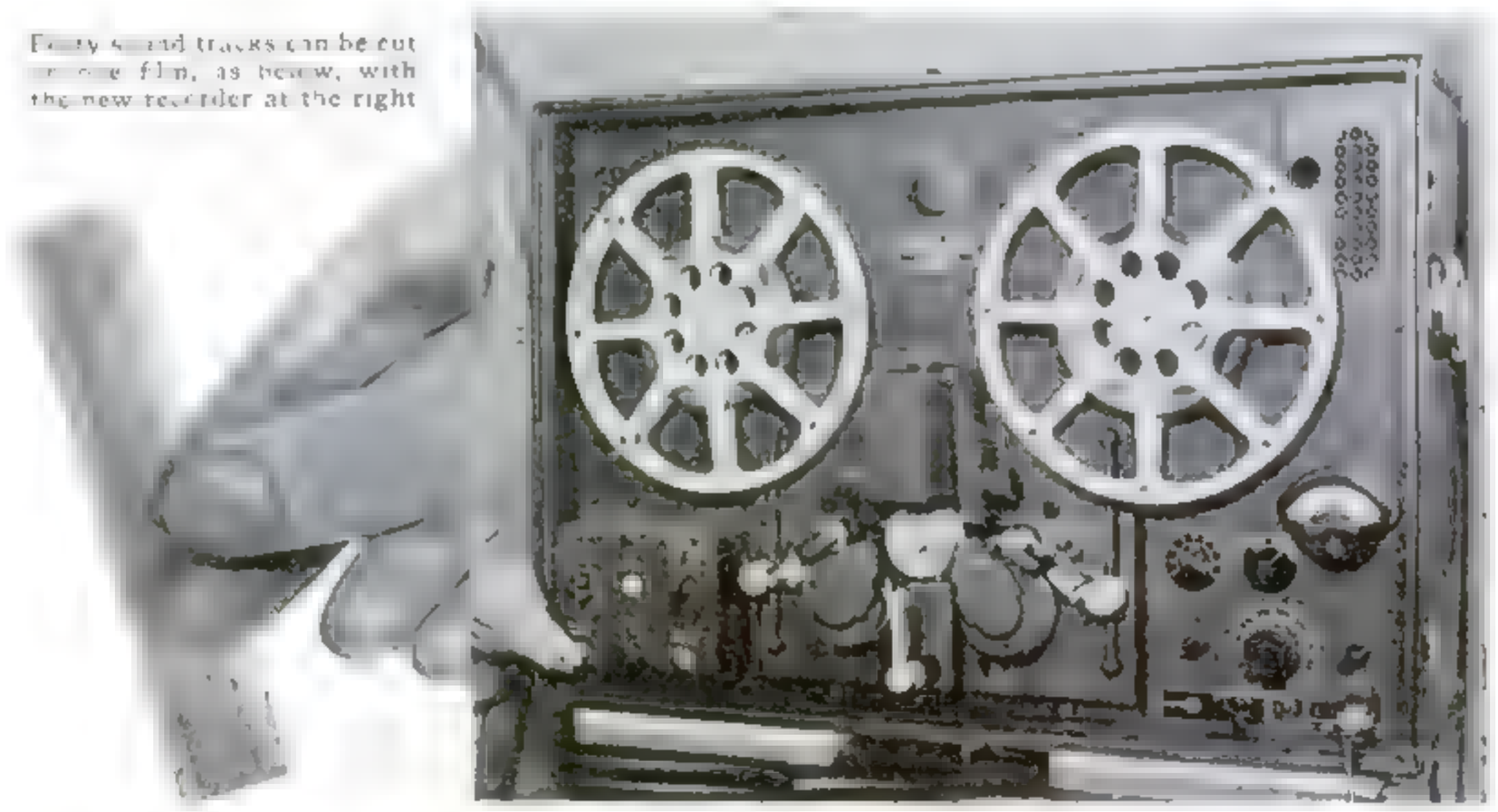
HAIR BRUSH AND COMB ARE COMBINED

BY COMBINING a comb and hairbrush, an ingenious manufacturer has produced a handy aid to keeping a well-groomed appearance. The bristles radiate from the back of the fine-toothed half of the comb, so that a deft user can apply a finishing touch with both comb and brush simultaneously. When the two-in-one novelty is inverted, the brush may be used alone.



With this two-in-one unit you can comb and brush your hair in one operation

Forty sound tracks can be cut on one film, as below, with the new recorder at the right



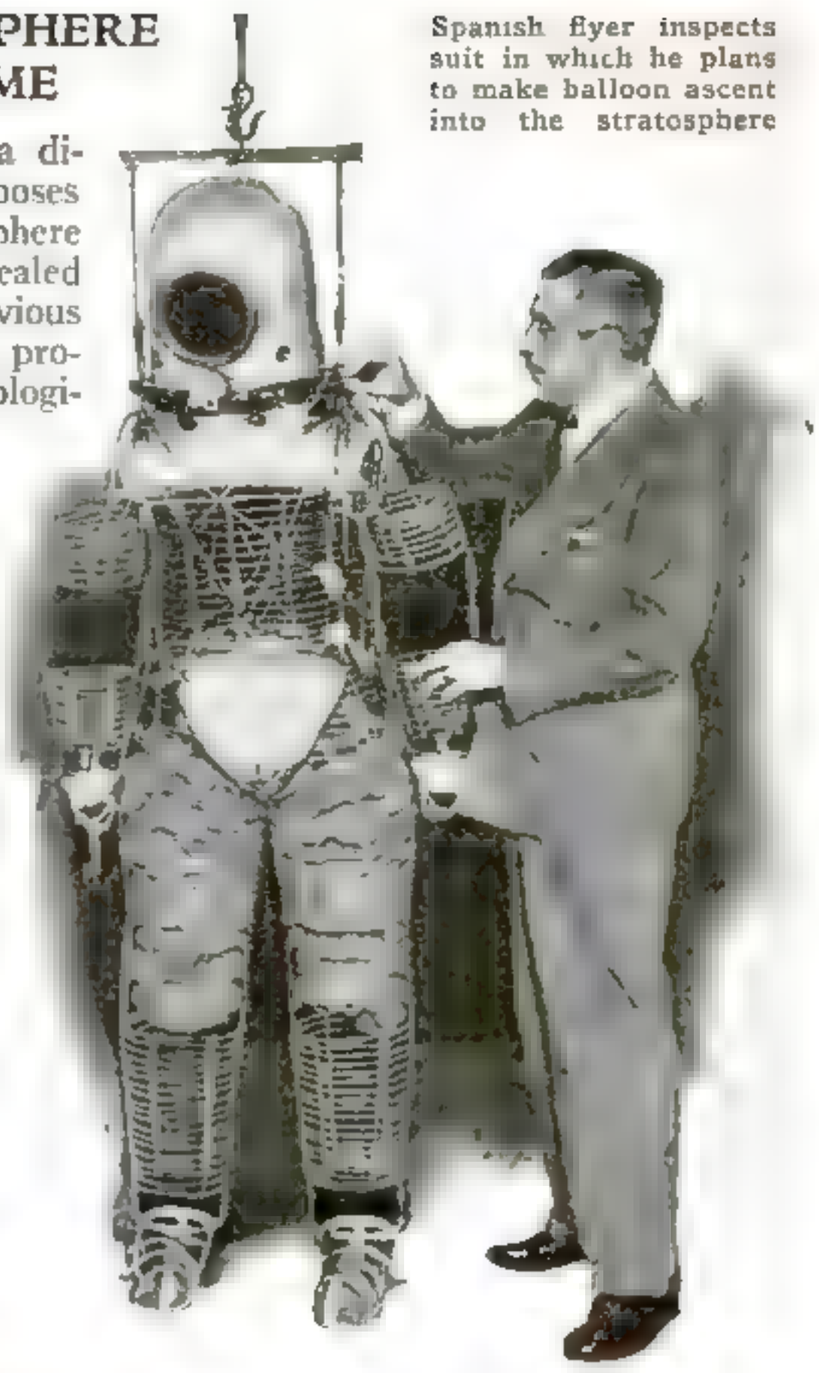
FORTY SOUND TRACKS ON ONE FILM

A FULL-LENGTH novel, the whole daily program of a radio broadcasting station, or the entire course of a court trial or political convention can be crammed upon a single reel of sound film by a recording and reproducing system recently demonstrated in New York City. Speech and music, picked up by a microphone, are imprinted by a diamond-pointed stylus upon a 2,000-foot reel of sixteen-millimeter film, in forty parallel sound tracks. As each track is filled the stylus shifts automatically to the next vacant space. Since there is no photographic emulsion to develop, the record can be played back immediately. A single reel provides a thirty-seven-hour program.

This artificial coconut palm is an example of the movie "props" fashioned from a new flexible-glass material

WILL DARE STRATOSPHERE IN WEIRD COSTUME

USING a costume resembling a diver's suit, a Spanish aviator proposes to ascend 60,000 feet in a stratosphere balloon without recourse to the sealed metal globes that have carried previous adventurers to such heights. For protection against the adverse physiological effects of the reduced air pressure, he will rely on a metal oxygen helmet and air-tight clothing reënforced with metal bands in such a way that it is sufficiently flexible to permit free movement but strong enough to keep the air within at the right pressure.



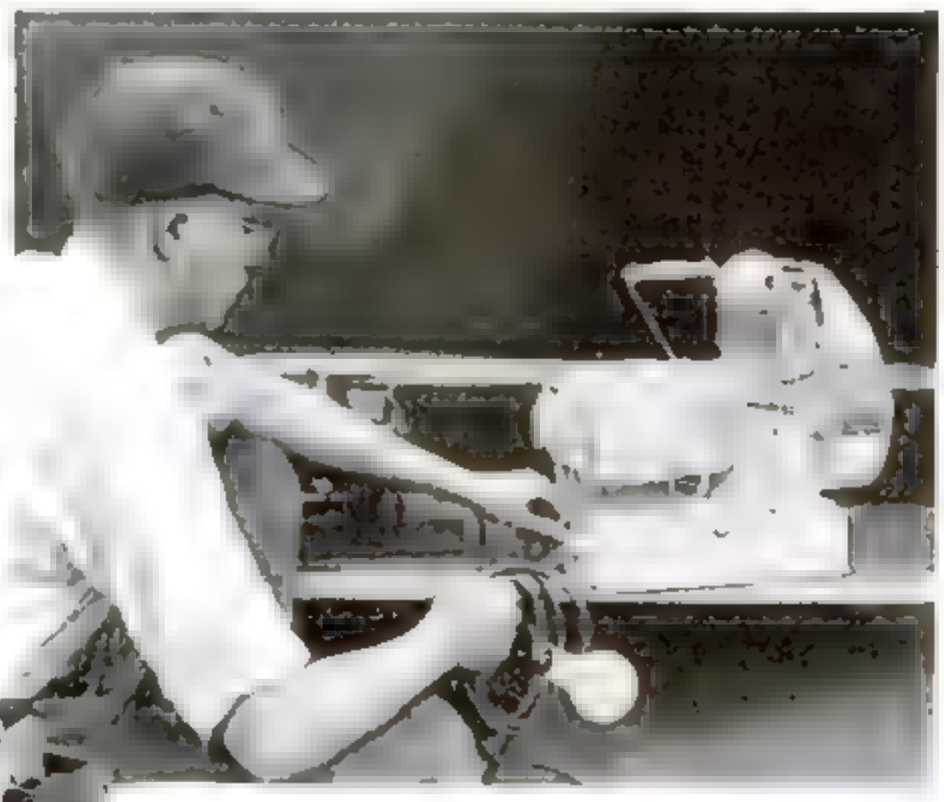
Spanish flyer inspects suit in which he plans to make balloon ascent into the stratosphere

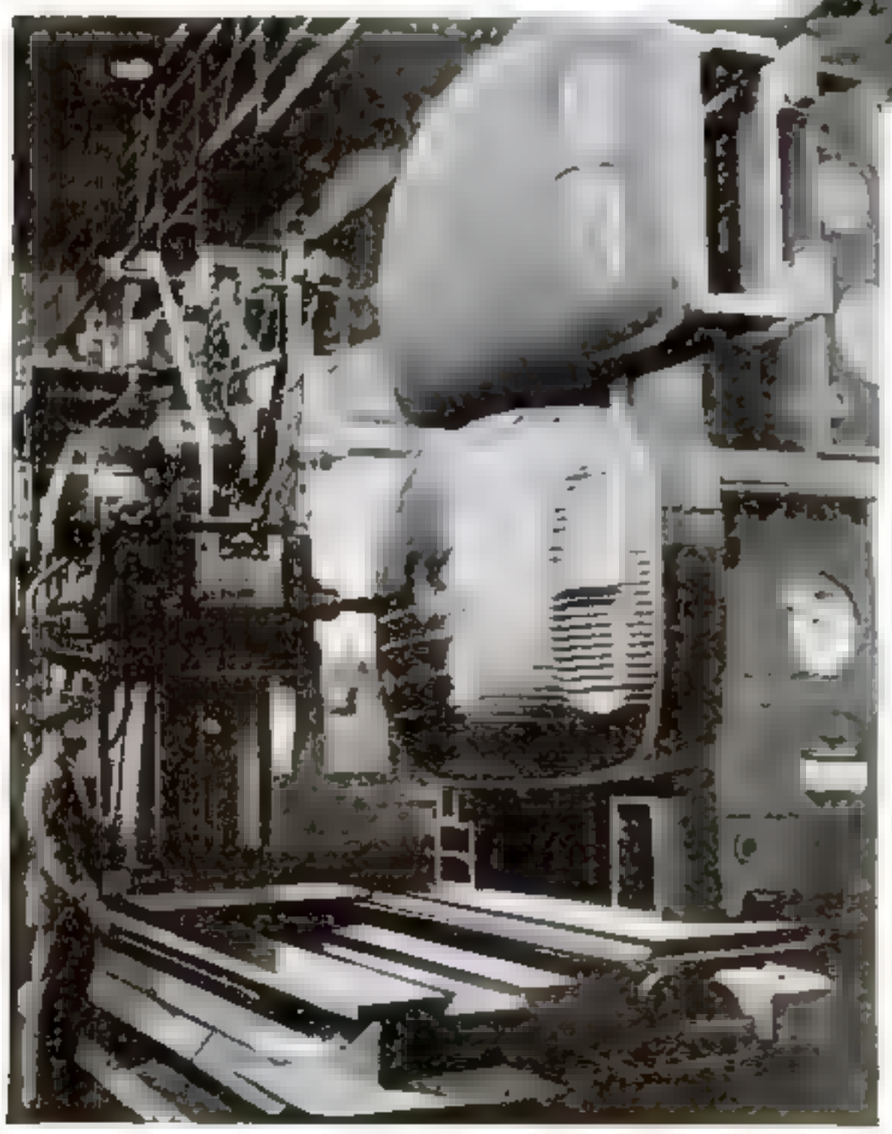
MOVIE PALM TREES MADE OF GLASS

PALM TREES of glass are being employed for scenic effects in a Hollywood, Calif., movie studio. The material, a new flexible compound developed in an Austrian laboratory, can be used for stage properties, auto windshields, and other applications where extreme elasticity is desirable.

MACHINE CUTS HUGE DIE FOR MAKING AUTO TOPS

NINETY to 100 automobile tops an hour will be turned out by the world's largest die, manufactured by a Detroit, Mich., factory, when it is mounted for use in a huge hydraulic press. A die cutter of record size, working on the same principle as the key-cutting machine of the corner locksmith, was used to produce it. The tool first rough-cuts and then finishes a die, the cutter being guided by a sensitive feeler passing over the mahogany master model that can be seen at the top of the photograph shown below.





World's largest die cutter forming a die for stamping out automobile tops. At the top is the mahogany master model

TINY POWER PLANT SUPPLIES LIGHT FOR CAMPERS

WEIGHING only fifty pounds, a portable lighting plant now available supplies power enough for a dozen twenty-five-watt lamps or their equivalent. The compact outfit measures seventeen inches long, nine inches wide, and fourteen inches high, and is suitable for use in a small cottage, tent, or auto trailer. A three-quarter-horsepower gasoline motor operates either an A.C. or a D.C. generator.

Portable gasoline-powered lighting plant, shown on the running board of a car to demonstrate its size

LIFELIKE DUMMY HELPS TRAIN FOOTBALL PLAYERS

TO AID in teaching players the correct way to block out opponents, a novel 400-pound football dummy is used by the coaching staff at Brown University, Providence, R. I. Made of padded materials, covered with canvas, and dressed in football togs, the practice dummy is supported in a lifelike position by a powerful spring mechanism which enables it to offer strong resistance in all directions when hit by players during blocking practice. Because of its realistic action, it is said to afford much better training than the sandbag dummies usually employed for the purpose.

A spring mechanism in the mounting of this football dummy makes it resist "blocking" like a real player

QUIET PNEUMATIC DRILL CARRIES ITS OWN MOTOR

OPERATED by a small gasoline engine, a unique pneumatic drill for making road and street repairs is a completely self-contained unit requiring no outside hose connections. The machine is incased in a special housing to muffle the hammering, nerve-racking noise of conventional drills. In the photograph above, a famous British neurologist is trying out one of the drills at a recent demonstration.

GRASS PROMOTES GROWTH

GRASS juice squeezed from lawn clippings promotes health and growth, according to laboratory tests with rats just completed by Wisconsin scientists. The juice was mixed with fresh milk.

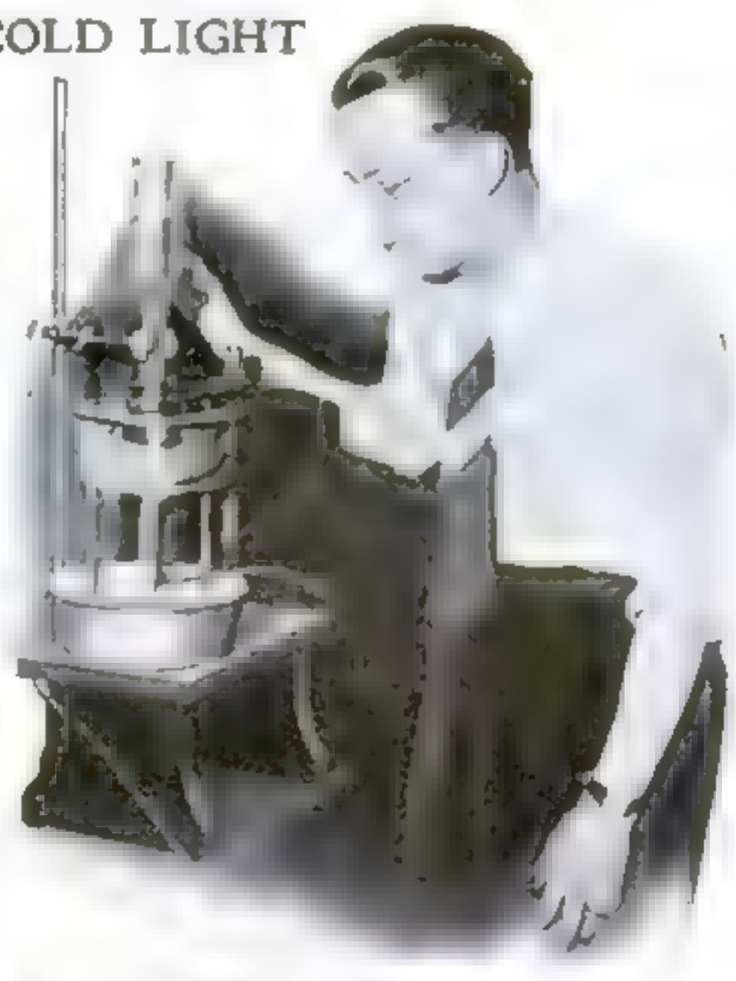
MOVIE CAMERA HELPS DETECT "DRUNKS"

LAWBREAKERS suspected of intoxication undergo a unique sobriety test before a movie camera to provide Pasadena, Calif., police with permanent evidence of their condition. Under the glare of powerful flood lights, the suspected "drunk" stands before a series of parallel lines painted vertically on a wall. As the subject walks away from the lines and approaches the camera lens, the film records any weaving, swaying, or stumbling motions. Hand-and-eye coördination tests are also similarly recorded on film, affording further proof for subsequent use.

Police making a permanent movie record of a test to determine whether a prisoner is intoxicated

SOUND IN WATER MAKES COLD LIGHT

COLD LIGHT, made from sound vibrations in water, has been produced by a Pennsylvania scientist. Intense sound vibrations are made to produce "holes" in water, similar to the pockets created by a ship's propeller. When these evacuated spaces collapse, liquid rushes in with great force, and light is generated, due probably to the rapid vibration set up by the impact among the atoms of the turbulent water as it whirls back into the pockets.



Dr. Leslie Chambers with his apparatus for producing cold light from sound vibrations in water

Representing their sport at a festival held in Moscow during the summer, these skiers are gliding over the cobblestones on skis fitted with rollers. They wear an abbreviated winter costume

USE ROLLER-SKATE SKIS IN SPORTS PARADE

SKIERS participating in a recent Russian sports parade held in Moscow used odd skis fitted with ball-bearing wheels similar to those on roller skates. Dressed in winter pants and boots, the skiers "marched" in front of the reviewing stands by propelling themselves along with the aid of their ski poles.

NEW HAIRPIN HAS CLIP TO HOLD CURL IN PLACE

WOMEN who are annoyed by curls that will not stay in place can now obtain hairpins designed to hold the hair firmly. Fashioned from a single piece of thin wire, each pin is bent back to form a small wire clip which holds the curl neatly in place. The pins are inconspicuous, making the coiffure appear more natural.

BALLOON TIRES FOR BABY BUGGIES CLIMB CURBS WITH COMFORT

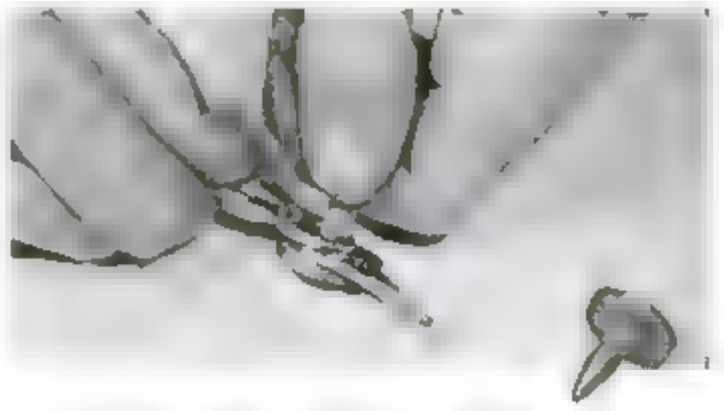
BALLOON TIRES that look like the low-pressure types used on automobiles are now available for use on the small wheels of baby carriages. Having a distinctive tread pattern and operating on an air pressure of only eleven pounds, the diminutive tires are essentially miniature replicas of standard models. They are said to absorb practically all jars and shock caused by irregularities on the road or sidewalk, and to travel easily and smoothly over gravel, lose dirt, or grass lawns. Bumping over curbs is also made more comfortable by the modern carriage equipment.

This up-to-the-minute baby carriage is equipped with balloon tires

EASY PROCESS DECORATES BOOK EDGES

Transfer paper being applied to the edges of a book to create the marbleized effect seen in library editions

MARBLEIZED decorative designs are easily applied to the edges of books with a new transfer paper which resembles decalcomania and is applied in much the same way. The book to be decorated is placed in a hand press and its edges rubbed with an alum solution. When this is absorbed, the selected transfer-paper design is placed face inward against the surface, moistened on the back with cold water, and pressed on firmly. The transfer paper is then carefully peeled off and the colorful design appears on the page ends. Unskilled workers using the new process are said to achieve results comparable to those obtained by hand methods.



RUBBER KEY HOLDER PREVENTS JANGLING

RESEMBLING a large tack made of rubber, a "silent" key holder, shown above, holds several keys securely and prevents them from jangling together. Pulling on the rubber point of the holder reduces its diameter and allows it to pass through the hole in the end of a key. When the pull is released, the rubber point resumes its normal size, squeezing against the hole to clamp the key securely.

NOSE SPRAY MAY CHECK INFANTILE PARALYSIS

DEVELOPED by the U.S. Department of Health in experiments with monkeys, a new treatment for preventing infantile paralysis is now being tested for the first time on humans in areas where the disease is prevalent. It consists of spraying a simple chemical solution into the nose of the patient with an ordinary atomizer.

COAT OF PAINT KEEPS ENGINES COOL

ALUMINUM PAINT applied to automobile engines has been found to improve the cooling of the motors, as well as to add to their appearance and protect the exposed surfaces from corrosion. The metallic coating, which is sprayed on by a high-pressure paint gun, has an exceptionally high heat conductivity, and because of its brightness and sheen, it acts as an efficient reflector to dissipate engine heat into the outside atmosphere. The use of the aluminum paint is said to increase the efficiency of the motor.

MOLECULES ARE GRADED

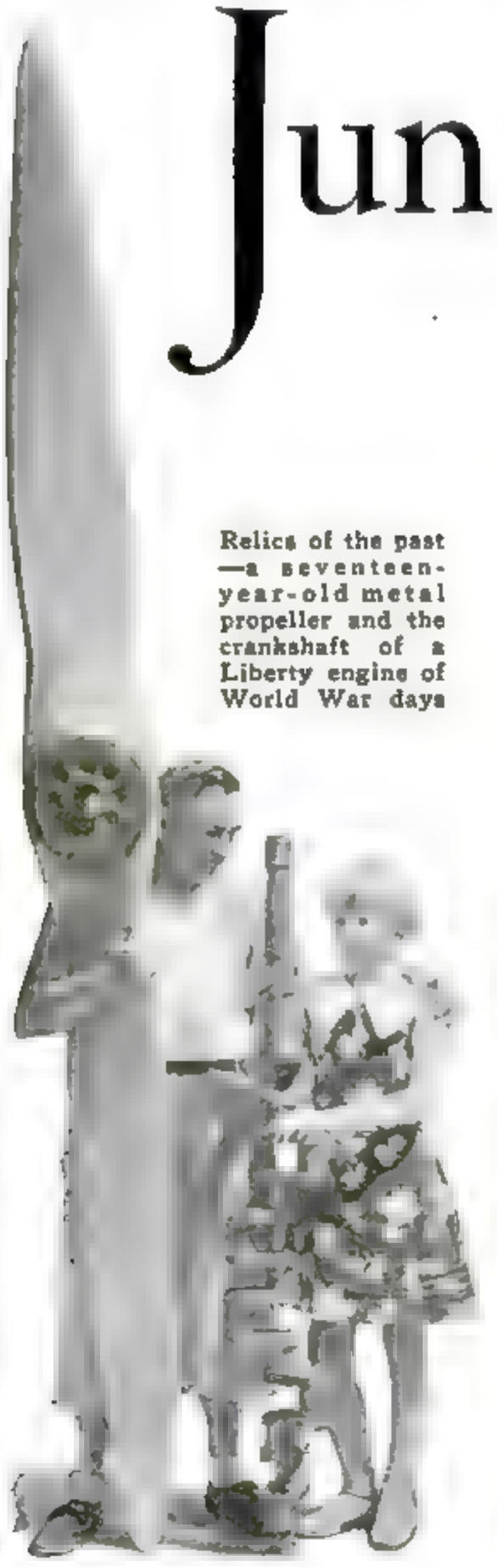
CHEMISTS have succeeded in grading molecules according to size in much the same way that a cannery sorts peas by passing them through a sieve. The chemical "sieve" consists of a cellulose membrane.

A workman spraying aluminum paint on an automobile engine. The metallic coating promotes the cooling of the motor and prevents rust

Arrigo Balboni, "flying junkman" of Los Angeles, Calif., on a pile of metal airplane skeletons salvaged from ships that went up in flames

FAMOUS PLANES
find last landing in

Junk Yard of the Air



Relics of the past —a seventeen-year-old metal propeller and the crankshaft of a Liberty engine of World War days

AT THE END of the sky trail, the remnants of 1,200 airplanes repose today in the world's only junk yard devoted solely to wood and cloth and steel which once flashed through the skies. Arrigo Balboni, former barnstorming pilot and member of Uncle Sam's air force during the World War, conducts this novel business. In his Los Angeles junk yard you can find at least a part of nearly every type of airplane ever built in the United States.

Ghosts of planes once famous figuratively rub shoulders with the skeletons of unknown ships whose pilots went to forgotten deaths. From ships which once rocketed to world records or carried famous people to oblivion, souvenir hunters purchase bits of cloth, pieces of wood, an instrument or a control, sometimes at high prices; but undamaged parts of the unknown planes go to practical men who use them in rebuilding all sorts of craft.

Through Balboni's shops have passed thirty air-mail and air-line wrecks, and more than 1,100 private planes. Some had burned, others were merely torn apart. Recently, an airliner crashed near San Diego. Three days later, Balboni bought the ship minus the engines for five dollars. The next week, he rented the carcass to a Hollywood studio for one day, receiving fifty dollars rental and twenty-five dollars for delivering it to the location. The following week, another movie company paid him twenty-five dollars for the privilege of shooting a few scenes around the fuselage as it lay on his back lot.

Strangely, Balboni got his start in airplane salvaging when he plunged into the side of a southern California mountain twelve years ago. As a barnstorming pilot, he accepted an invitation from the late Al Wilson, motion-picture pilot and promoter of air meets, to fly his Jenny from San Francisco to Los Angeles for the 1924 Armistice Day air meet there.

On the way down California, Balboni cracked up and barely escaped with his life. Next morning, he had the promoter of the meet on the telephone. "I'll give you fifty dollars for the ship as she is, seventy-five dollars if you'll bring her to Los Angeles," Wilson offered.

For five days Balboni perspired on the mountain side, directing an assistant in detaching the wings, skidding the engine down a ravine, dragging the fuselage eight miles to the state highway. There he piled the remnants in a trailer and started for a hangar at Mines Field.

Balboni stopped at Lancaster for a cold drink, and sold the magneto for twenty dollars to the proprietor of the hot-dog stand, who likewise was an aviation enthusiast. At Palmdale, another desert town, an amateur pilot acquired the axle, at six dollars. By the time Balboni reached Los Angeles, seventy-five dollars was jingling in his trousers pockets for various parts, and he still had the bulk of the machine on his hands.

"Did Al Wilson keep his promise?" I inquired.

"Never had a chance," Balboni grinned. "I had spent $350 building that old crate, and finally sold the wreckage, piece by piece, for $930. More money than I could make racing, I discovered."

With the proceeds, the "original flying junk-

To this strange airplane graveyard come pilots in search of odd parts, and souvenir seekers for mementos of craft that have met tragic ends

By JOHN E. LODGE

man of the air," as Balboni soon was calling himself, began to prove that airplanes which come to earth on their backs, nose first, and in various other unorthodox fashions are frequently worth more than when new.

While enjoying the fruits of his first sales, he heard that an enthusiastic but imprudent flyer had landed his Standard biplane in some telegraph wires near Ventura. Balboni jumped into a car and dashed sixty miles to the scene, where he saw the remains of the plane heaped up at the edge of a field. The owner was glad to take ten dollars for full title to the fluttering canvas and fractured spars. Late that afternoon, Balboni pulled up alongside the road in San Fernando, called a young man he knew was interested in building a plane, unloaded the wreckage, and drove away with eighty dollars.

The following week, he saw an item in a Los Angeles newspaper which stated that two Fresno flyers had landed their two-place biplane upside down, with fatal results. The next morning Balboni went knocking on doors until he learned who had inherited the craft. He handed over fifteen dollars and departed, with the wreck rolling on its wheels behind his car, and the wings lashed securely to the roof. On the way to Los Angeles, 215 miles distant, he sold sixty dollars worth of parts, and arrived home with the fuselage, wings, and engine virtually intact.

This novel enterprise soon began to attract attention. Friends called him whenever a plane smacked the earth a little too hard. Strangers heard of him, and tips commenced to reach him from all parts of the western United States. Soon he was branching out into wholesale purchases of everything and anything connected with aviation.

At San Diego, seventeen OX5 motors were damaged in a fire. Balboni offered $850 for the lot. Back in Los Angeles, the enterprising junkman scoured the smoked blocks with soda, and painted the crank cases with silver powder. Within a few weeks, all had been sold, and the daring purchaser rang up a profit of nearly $5,000.

But the bulk of Balboni's business is still in smashed planes which have figured in newspaper accounts of accidents. He seeks part, at least, of every craft that crashes in the western United States. The better known its occupants, the more valuable the parts, particularly for sale to souvenir hunters.

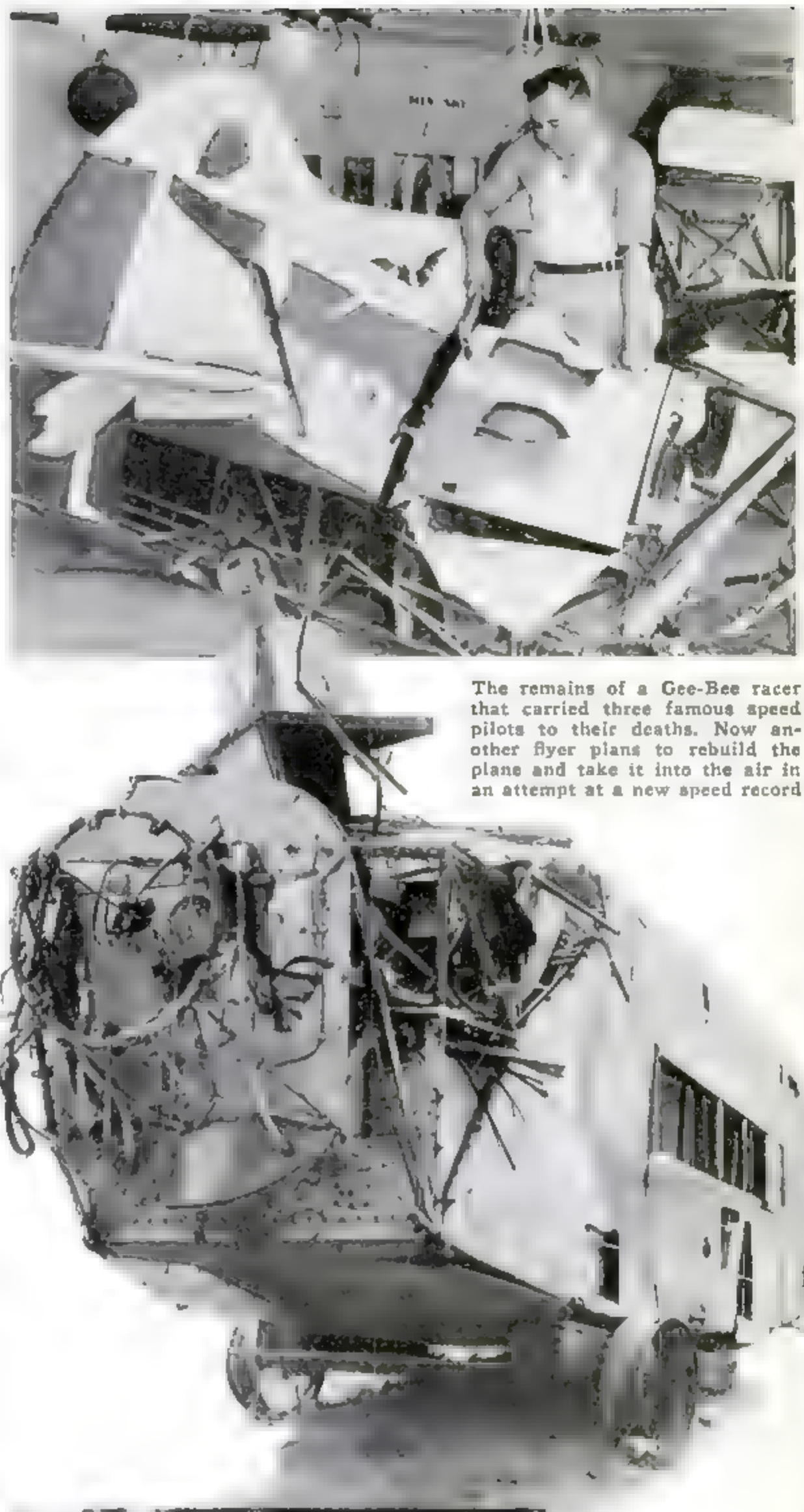
Whenever the wrecks contain enough wood and metal to permit it, he takes the best parts from a half dozen and builds a new plane. In fact, he rebuilt one biplane eight times and sold it nine times.

Although the "flying junkman" will go to any length to obtain a wrecked plane, he will not pay more than fifteen dollars for the "best wreck" he ever saw. When Knute Rockne fell on the Kansas plains in an airliner, Balboni hopped into his plane and winged his way east. At the scene of the tragedy he could find no one with authority to sell the wreckage, in whole or in part.

"So I did what I saw others doing," he declared. "I helped myself to canvas, plywood, and some other parts lying around. When I started west I was selling plywood for a dollar a square foot, but as the stuff got scarce I began charging that much for a tiny piece. On the way to Los Angeles, I sold $260 worth of these fragments."

Balboni kept one hose coupling as a memento of that crash. In fact, he tries to keep some part of each wreck that rolls into his junk yard. In his vast collection are parts of fully 1,000 planes. Some merely have broken wings, others stand as gaunt steel skeletons of once proud birds, while from many he possesses only some small part.

Among the countless mementos from all sections of the world, I saw a piece of red plywood from the plane that Col. Charles A. Lindbergh *(Continued on page 117)*



The remains of a Gee-Bee racer that carried three famous speed pilots to their deaths. Now another flyer plans to rebuild the plane and take it into the air in an attempt at a new speed record

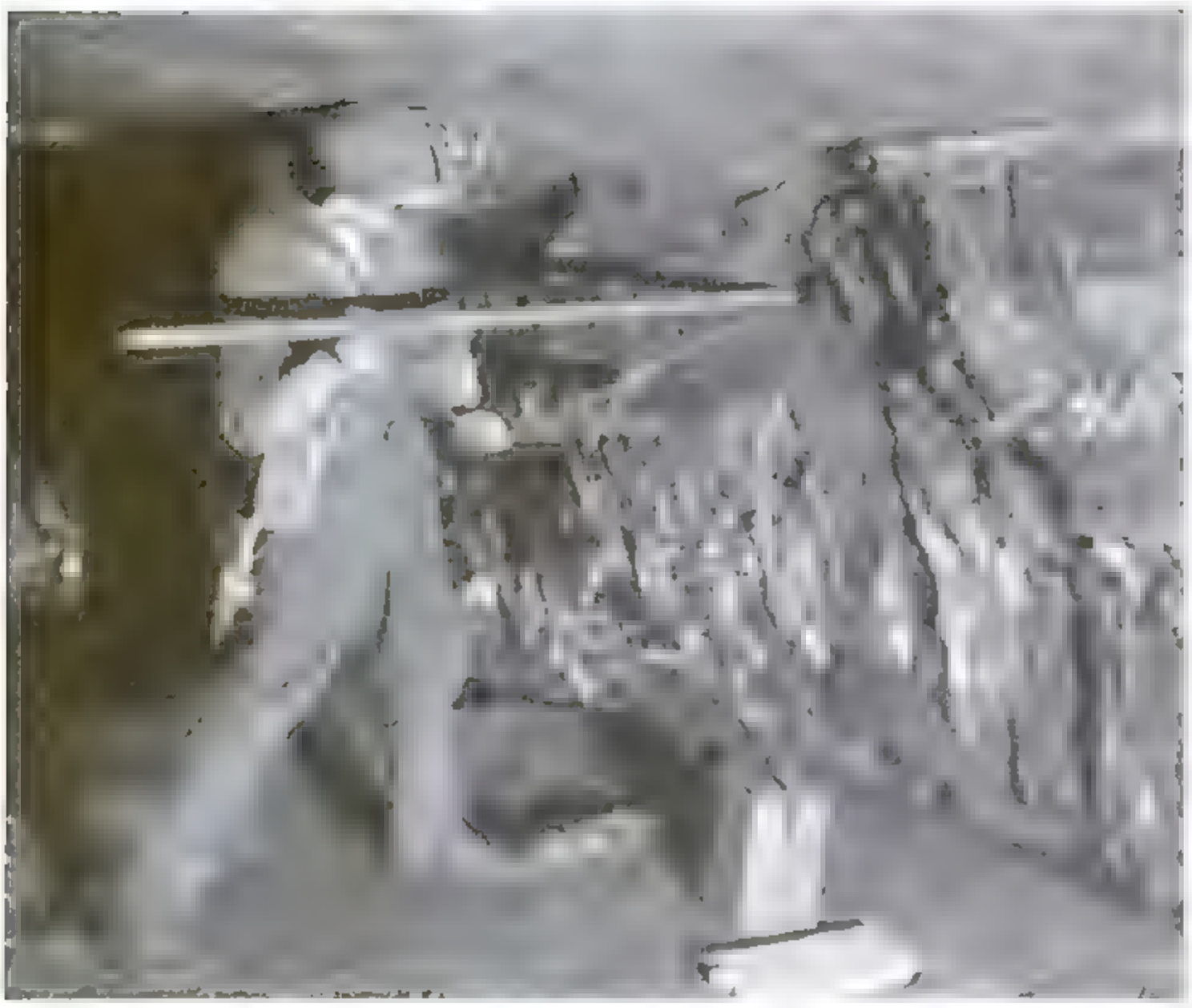
Balboni bought this fuselage of a trimotored airliner for five dollars and made a handsome profit renting it to movie studios for shooting wreck scenes

A ROLL OF HONOR OF THE AIRWAYS

A customer signing his name in Balboni's "Gold Book," which contains the signatures of many famous flyers. There are already 13,000 names. If one of them dies, a golden cross is marked beside the flier's signature

Secrets of COAL

SOLVED IN UNIQUE LABORATORY



A coal miner driving home a charge of dynamite preparatory to blasting away a layer of coal that has been undercut by machine. This is a typical operation in the mining of coal

WHEN you pause for breath, lean on your shovel, and gaze into your coal bin, you probably see little more than a black mass that cost you so many dollars a ton. But in Pittsburgh, Pa., in a laboratory that might be called the Scotland Yard of the coal industry, there is a man who could show you unbelievable wonders in a humble piece of coal. He could offer good reasons, other than the size of your winter fuel bill, why coal has been nicknamed "black diamonds."

That man is Dr. Reinhardt Thiessen, research chemist at the U. S. Bureau of Mines Experiment Station, and world authority on the microscopic structure of coal and related substances. In his unique laboratory, this Sherlock Holmes of the coal world is unraveling the hidden mystery of "black diamonds," and bringing to light details that enable experts to understand better how coal is formed, and how it can best be used.

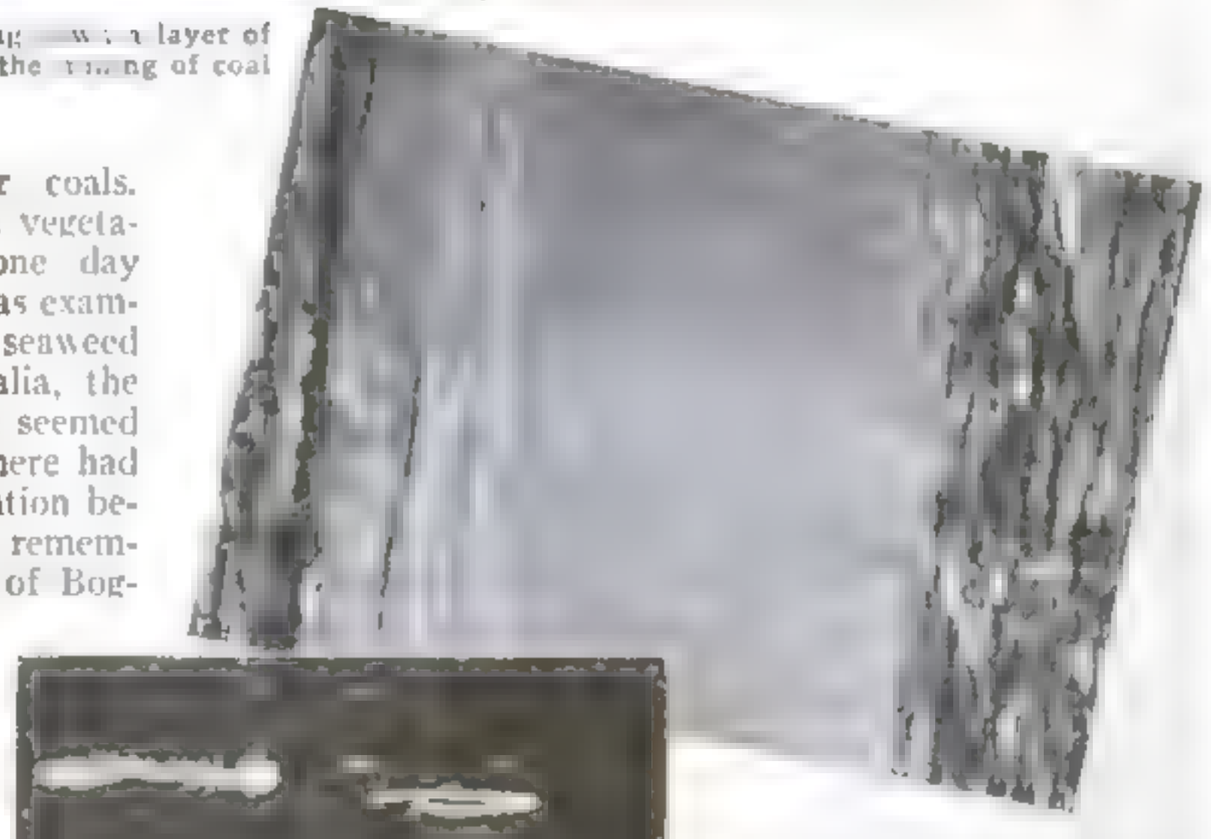
As an illustration of his work, take the case of Boghead coal. This variety, which is dark brown in color, got its name from the town of Boghead in Scotland. For years, experts puzzled over the important question of the vegetable matter from which this coal was formed. Dr. Thiessen had peered through his microscope at thin sections of it hundreds of times, but had found no clews. The specimens contained none of the familiar, telltale spores or woody cells that enabled him to identify the origin of other coals.

Coal is basically a vegetable material, and one day when Dr. Thiessen was examining a specimen of seaweed brought from Australia, the microscopic structure seemed vaguely familiar. Where had he seen such a formation before? Suddenly he remembered the thin slices of Boghead coal that had baffled him previously, and the mystery began to clear up. Further research enabled him to prove definitely that Boghead coal was formed, millions of years ago, from marine plants that were the prehistoric cousins of the type of seaweed growing in Australia at the present time.

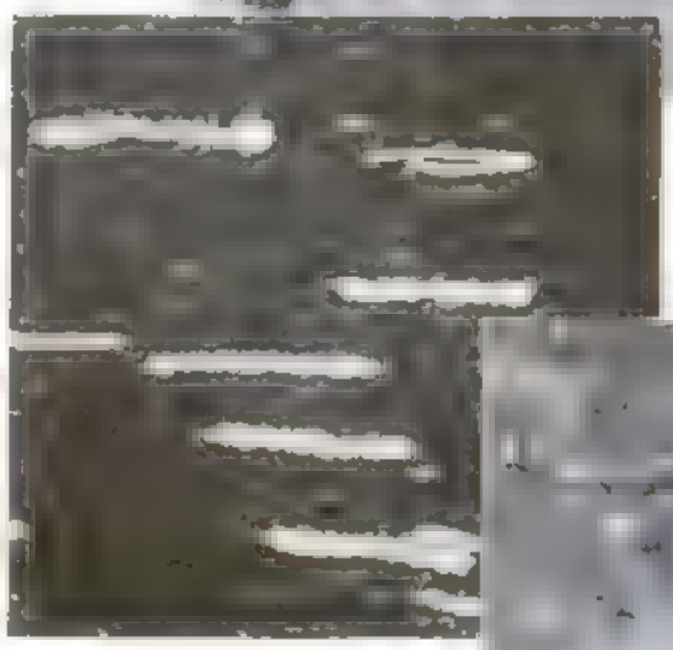
Nature formed the coal that is mined today from plant life growing in peat swamps long before the dawn of recorded history. Through century after century, this plant matter gradually decomposed through the action of fungi, bacteria, insects, and natural weathering. Finally, it was covered by rock and compacted into a mass rich in carbon, combined with lesser amounts of hydrogen, oxygen, nitrogen, and sulphur. This carbon mass we know today as coal.

The carbon in coal is the same as the pure type found in diamonds and graphite. But to call coal "black diamonds" is not strictly correct. For coal contains other elements besides the carbon which gives it kinship to the precious stone—and also, coal is not necessarily black. Under the microscope, it is much more likely to be red, or brown, or yellow.

To prepare a chunk of coal for microscopic examination of its color and structure, Dr. Thiessen, or one of his assistants, slices off a thin section of it with a



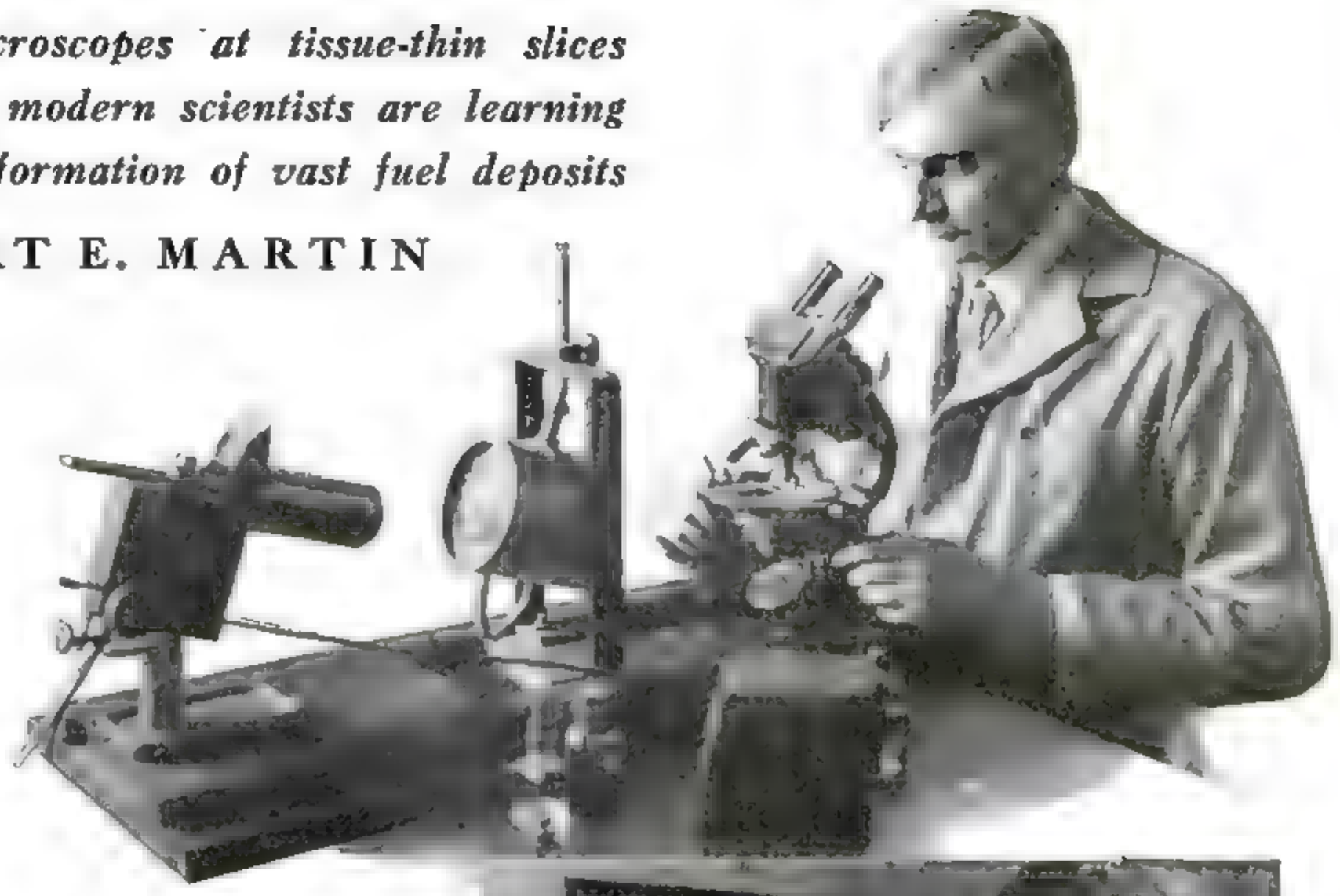
The cell structure of a prehistoric plant is visible in this magnified coal section



The light-toned objects in the photomicrograph above are plant spores embedded in coal and flattened by pressure. The dark patches in the section at the right are the resin from ancient trees

Peering through microscopes at tissue-thin slices of "black diamonds," modern scientists are learning new facts about the formation of vast fuel deposits

By ROBERT E. MARTIN



Dr. Reinhardt Thiessen at work in his laboratory in the U.S. Bureau of Mines Experiment Station in Pittsburgh, Pa. He is widely known as an authority on the formation of coal

circular saw similar to that found in many home workshops. An abrasive disk, however, replaces the conventional toothed saw blade, and the saw itself is incased in a cabinet to prevent the spread of fine coal dust.

The slice of coal, perhaps half an inch thick, is then polished and ground to remove all surface lines and scratches. It is next trimmed to fit a standard one by three-inch microscope slide. Cemented to the glass, it is subjected to further grinding, first on a rough-surfaced horizontal wheel, then on a wheel of finer grit, and finally on a flat razor hone lubricated by a stream of water. By this time, the coal slice is so thin that light can be seen through it.

As the last step in the process, the slide maker places the work over a small illuminated window in the inclined side of a box, and gives it a final polishing with a fine abrasive powder. Finally the specimen of coal, now from three to five one-thousandths of a millimeter in thickness, is covered with a thin piece of glass and held in place with Canada balsam—a procedure that is familiar to every amateur microscopist.

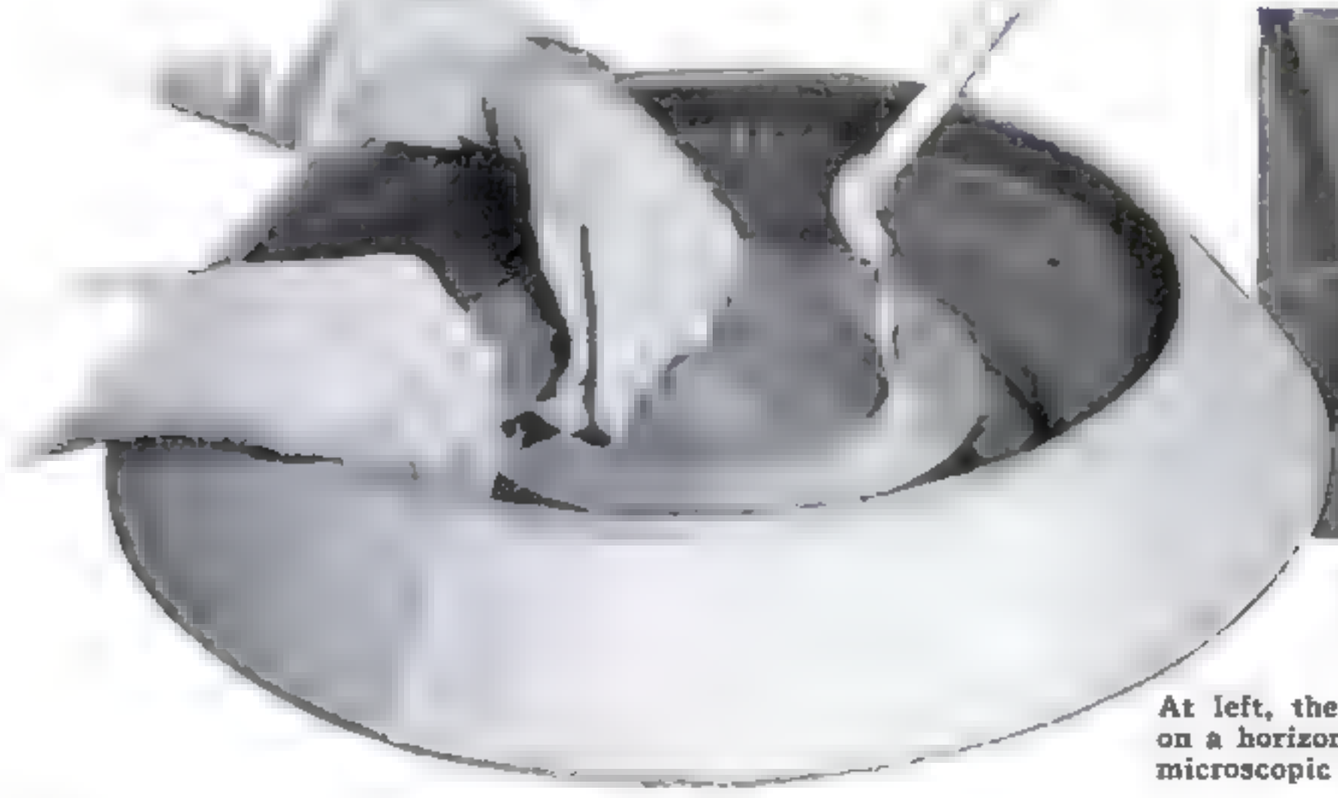
Developed by Dr. Thiessen's laboratory, this method of making microscope slides of coal is now universally used wherever coal research is in progress. Coal beds are rarely made up of the same material from top to bottom, so if an owner wants to determine the various types of coal a bed contains, he has representative sections taken from each layer and sent to the laboratory for microscopic examination.

When the microscopist slips a coal slide into his microscope, he may recognize a number of different coal characteristics. So that experts may have a common language for discussing their work, distinctive names have been given to the three outstanding types of material found in coal: anthraxylon, attritus, and fusain.

Of the three, anthraxylon and attritus are the more important materials; fusain, a dull, easily crumbled substance resembling charcoal, is found only in small amounts.

Anthraxylon consists of the fossilized remains of the woody parts, such as roots, stems, and twigs, of prehistoric plants. Viewed by the unaided eye, this material appears as a number of black strips, bands, and streaks, usually bright in appearance, and sometimes extending more than an *(Continued on page 120)*

A laboratory worker cutting a piece from a chunk of coal with a circular saw. The slice is ground and polished to remove surface scratches, and trimmed to fit a microscope slide, to which it is cemented as pictured at the right



On a flat razor hone lubricated by a stream of water, the microscope specimen is ground down so fine that light can be seen through it. The final polishing is with a powder

At left, the section of coal on its glass slide is being polished on a horizontal abrasive wheel. This method of preparing coal for microscopic examination was developed by the U.S. Bureau of Mines

PLAY VOLLEY BALL ON STILTS

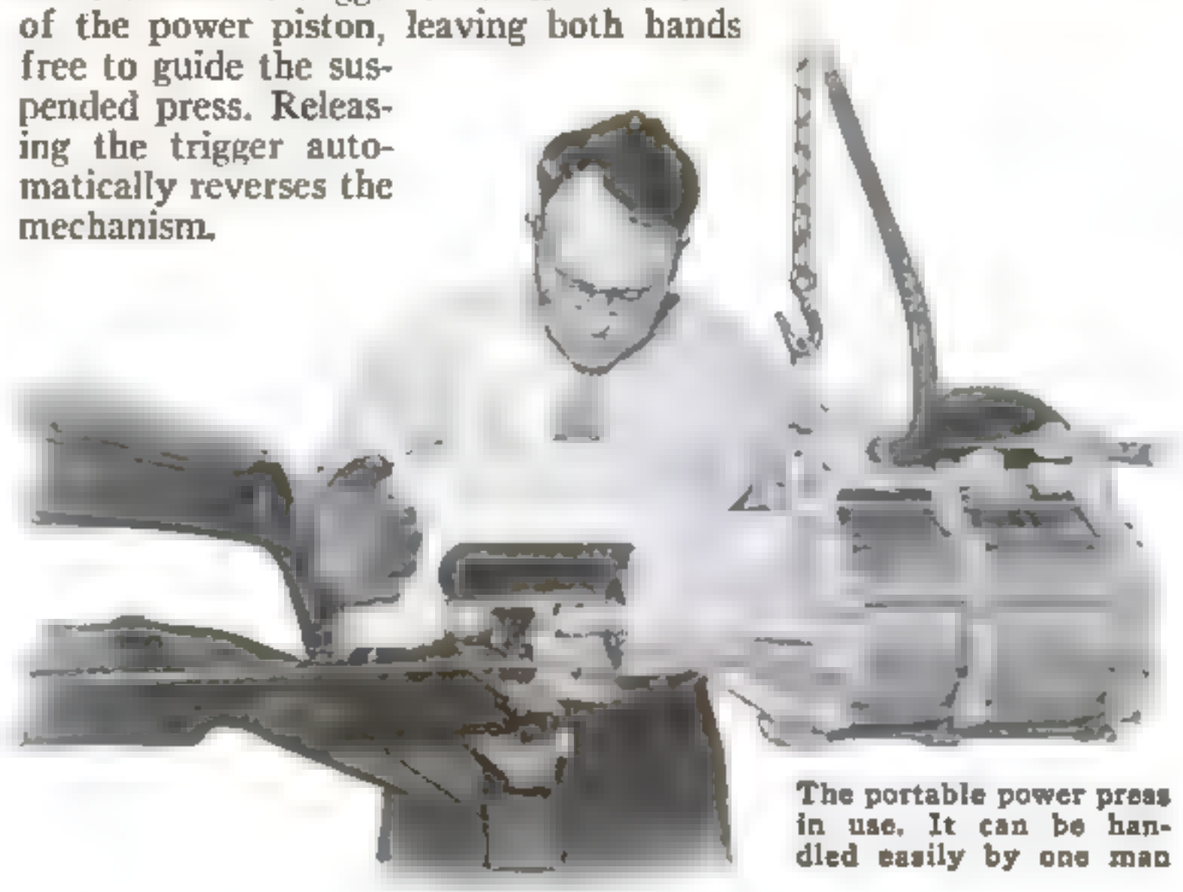
VOLLEY BALL on stilts is the newest game for bathers on the beach at Venice, Calif. As shown above, three of the four players on each side are mounted on twelve-foot stilts, while a fourth member remains on the ground as "retriever," to keep the ball in play and save the other players the trouble of dismounting from their stilts every time the ball falls to the ground in the course of the game.

PAPER TOUCH-UP TAPE REPAIRS CAR FINISH

REFINISHING scuffed or scratched surfaces on automobile bodies and fenders is simplified by a recently devised touch-up tape. A practical application of the familiar decalcomania, used for transferring designs, the tape can be put on quickly and easily, to match standard car finishes. The tape is simply covered with a special welding compound, applied to the scratch, chip, or bruise on the car, and its paper base stripped off. After drying, the spot need only be sanded and polished.

PORTABLE PRESS SPEEDS PRODUCTION

HEAVY assembly work, which heretofore required the use of large stationary power presses, now can be handled right on the production line with a new lightweight portable press. Constructed principally of aluminum and suspended by means of a delicate counterbalance, the unit can be moved and operated easily by one man. A thumb trigger controls the action of the power piston, leaving both hands free to guide the suspended press. Releasing the trigger automatically reverses the mechanism.



The portable power press in use. It can be handled easily by one man

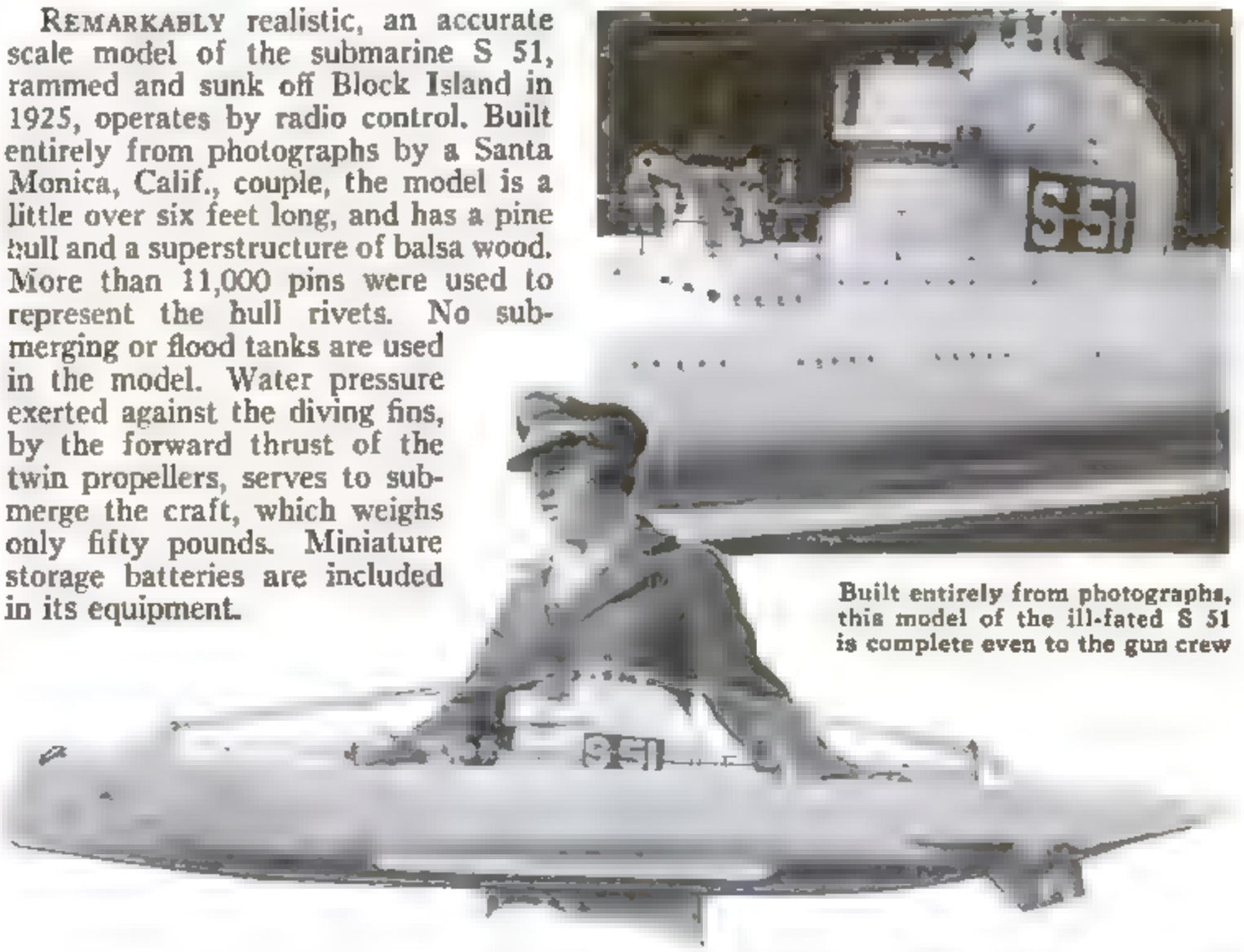
CUP-SHAPED BULLET HAS HIGH VELOCITY

SHAPED like the nipple on a baby's nursing bottle, a rifle bullet recently invented is said to have four times the acceleration of the normal .30 caliber projectile. A hollow base, twice the diameter of the body part, gives the exploding gases greater surface area on which to act, to speed the bullet toward its mark at 3,600 miles an hour. Special grooves in the rifle barrel reform the cup-shaped tail into fins, which steady the bullet on its flight.

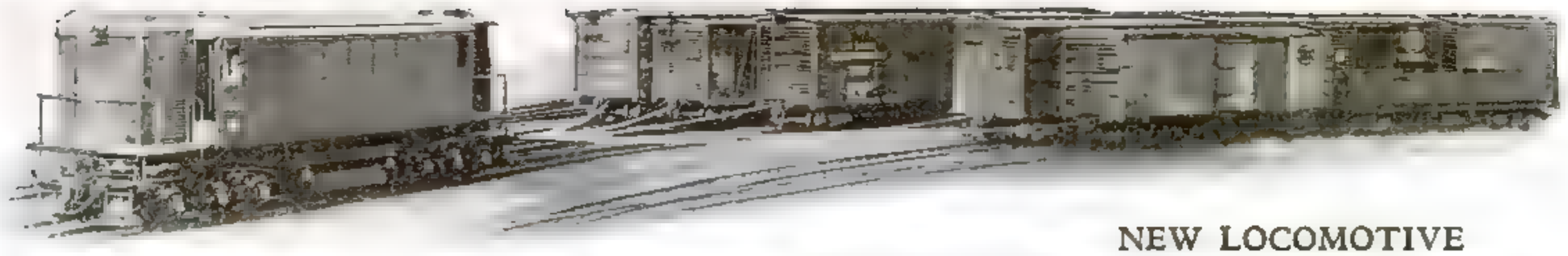
As the bullet travels through the narrow part of the rifle, grooves in the barrel shape the hollow, cuplike tail into stabilizing fins, as shown above

RADIO CONTROLS SUBMARINE MODEL

REMARKABLY realistic, an accurate scale model of the submarine S 51, rammed and sunk off Block Island in 1925, operates by radio control. Built entirely from photographs by a Santa Monica, Calif., couple, the model is a little over six feet long, and has a pine hull and a superstructure of balsa wood. More than 11,000 pins were used to represent the hull rivets. No submerging or flood tanks are used in the model. Water pressure exerted against the diving fins, by the forward thrust of the twin propellers, serves to submerge the craft, which weighs only fifty pounds. Miniature storage batteries are included in its equipment.



Built entirely from photographs, this model of the ill-fated S 51 is complete even to the gun crew



NEW LOCOMOTIVE PULLS FIVE TRAINS OF CARS AT ONCE

YOKED to five strings of freight cars at once, as shown in the photograph above, a new Diesel-electric locomotive gave a remarkable demonstration of its power in recent tests. Said to be the most powerful single-unit conbination of its kind ever built, the locomotive has been delivered to the Illinois Central Railroad for freight-transfer service in Chicago. Six electric motors, one on each axle, provide enough power to pull a 6,000-ton train and give a top speed, under lighter loads, of sixty-four miles an hour. Special construction reduces the weight while increasing the structural strength.

CHIMNEY BUILT AROUND DORMER WINDOW

WHEN the architect of a colonial house in Massapequa, N. Y., was confronted with the problem of erecting an outside chimney at a point where a second-story window was desired, he adopted the novel solution pictured. At the level where the window was built, the chimney splits into two sections to form a decorative frame of white-washed brick around the recessed dormer window.

STAINS GLASS BY MEDIEVAL METHODS

NOT SATISFIED with the texture or color of available types of glass, Lawrence Saint, an artisan commissioned to fashion two stained-glass windows for the National Cathedral in Washington, D. C., reverted to glass-making methods practiced by medieval master craftsmen in the twelfth century. The completed windows will contain 2,850 pieces of specially made glass, all of which have been painstakingly stained with paints and enamels in hundreds of different shades. To get the exact effect he desired, the artist found it necessary to experiment with several thousand stains, making 300 distinct tints of blue glass alone.

Lawrence Saint with a pair of stained-glass windows completed in his workshop. Left, preparing a delicate tint

MILK IS FROZEN TO PREVENT SPOILING

Milk from nursing mothers being placed in molds. "Dry ice" freezes the fluid to retain its freshness

TO PRESERVE milk from nursing mothers while it is being transported and handled, a New York child-welfare organization has adopted the odd expedient of freezing it into solid cylinders. Poured into sterilized molds that are packed in "dry ice," the milk freezes solid in less than two minutes and, if kept at a low temperature, can be transported and held for considerable periods of time without spoiling. Laboratory tests have shown that the fluid loses none of its beneficial qualities through the freezing process, and the solid form makes it easy to handle in a sanitary manner. In the photograph at the left, a laboratory worker is shown filling the sterilized molds with milk from a syringe.

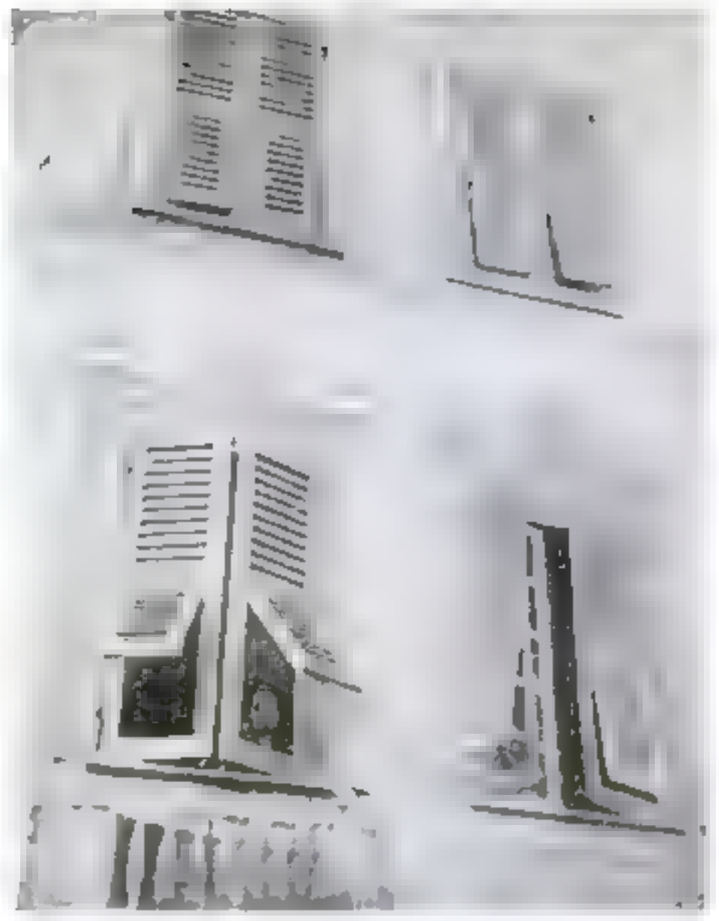
COMB TRIMS THE HAIR WITH BUILT-IN BLADE

EQUIPPED with a cutting blade, a hair comb now being marketed by a New York City firm cuts and thins the hair as it is used. A thin, sharp blade fits into a slot on the top of the comb and is held in place by a metal guard. The blade extends down into the teeth, which also are slotted to hold it in place.

ROCKET RAINS BULLETS ON ENEMY SOLDIERS

Maurice Poirier with a model of his proposed war rocket

SHOT into the air over enemy lines, a new rocket designed as a wartime offensive weapon will rain down bullets over a mile-wide area, according to Maurice Poirier, its inventor. Incased in a perforated metal nose, the missiles will be automatically fired at maximum altitude, while the rocket itself falls to the ground and explodes. As shown by the photograph at the left, made during a recent test at Burbank, Calif., the projectile is fired like an ordinary Fourth of July rocket from a trough supported by an easel. The propelling force, supplied by explosives in the lower end of the case, is expected to carry it to a height of 30,000 feet. Further tests are being made to bring the new weapon up to the expectations of the inventor and to determine its effectiveness under actual combat conditions.



WINDOWS AND SHUTTERS ARE PAINTED ON WALLS

MURAL paintings substitute for windows in many houses in the village of Camogli, Italy. Forced to economize on construction costs by eliminating many windows, builders preserved architectural symmetry by painting dummy windows on the walls. In the photograph, only the windows at the left are real.

GAS TANKS RISE FROM SOGGY SOIL

FLOOD WATERS, seeping through porous earth, uprooted the gasoline pumps at the filling station near Saratoga Springs, N. Y., pictured here. Underground tanks, empty at the time of the floods, acted as pontoons, raising and cracking the concrete platform.

Gasoline pumps uprooted by empty underground tanks rising to surface

NOVEL X-RAY PROCESS IDENTIFIES CRYSTALS

SOLID, crystalline substances are analyzed and "fingerprinted" by a new X-ray process recently perfected. When bombarded with X rays in a curious diffraction camera, a compound under test leaves a characteristic pattern of lines on the film negative. Just as the measurement of fingerprint whorls can be used for identification purposes, so the position and density of the lines on the film negative provide an accurate key to the nature and quantity of the elements present in the unknown compound. Although it is not applicable to liquids or noncrystalline substances, the chemical "fingerprinting process" is expected to prove of great value in metallurgy.

Dash light wired to battery electrode to show when water is low

LIGHT SHOWS WATER LEVEL IN BATTERY

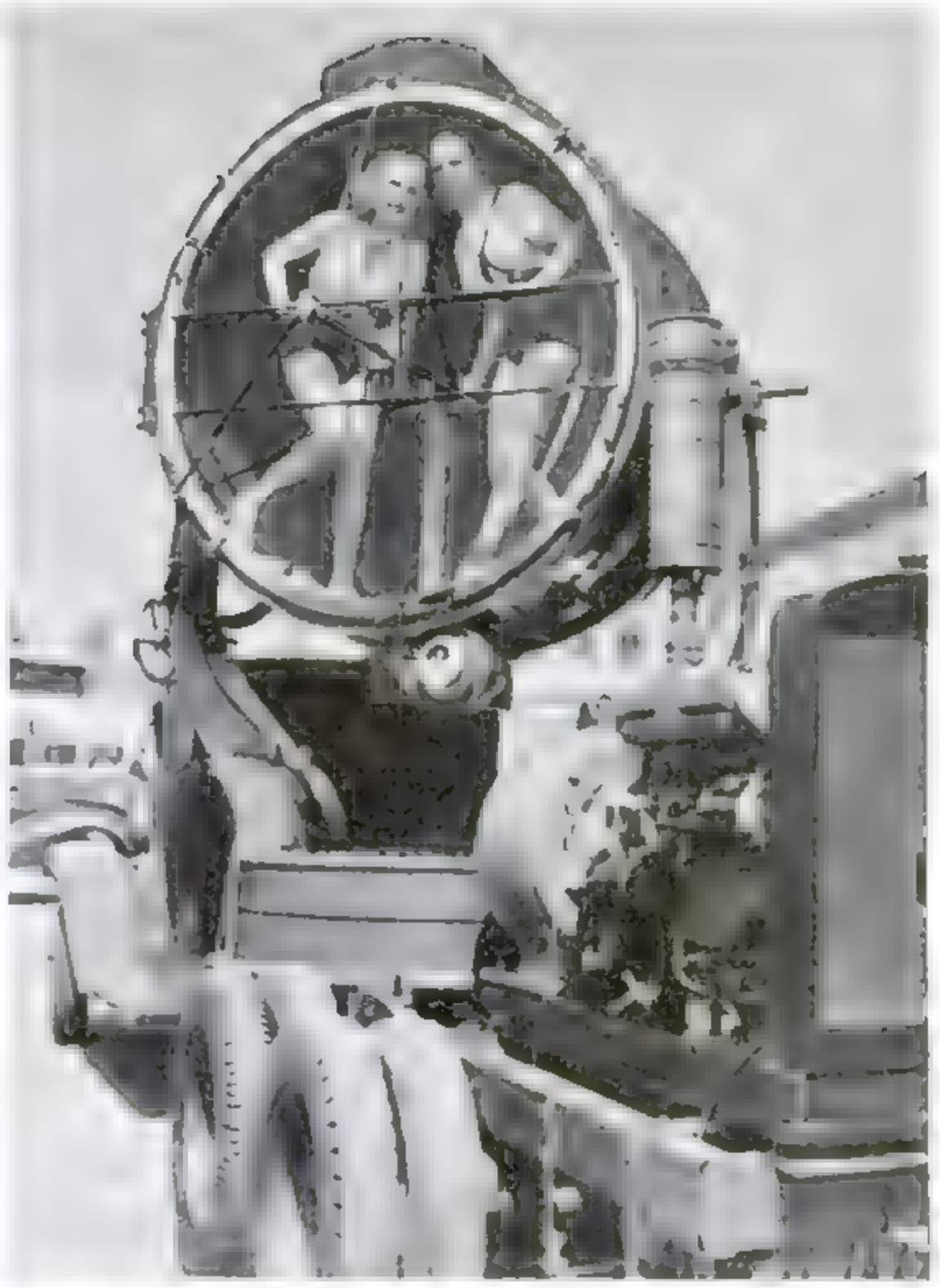
A DASHBOARD accessory recently marketed indicates whether there is sufficient water in an automobile battery. When a small translucent knob is turned, a pilot light within the knob glows if the battery water supply is adequate: otherwise it remains unlighted. The dashboard lamp is wired to a special alloy-metal electrode which extends into the battery cells through a hole in one of the vent plugs.

X-ray diffraction camera and a negative with lines that identify an unknown substance

MUSIC CHART MAKES TRANSPOSING EASY

Equivalent notes in different keys are shown on this odd colored chart

TO SIMPLIFY transposing musical compositions from one key into another, John Beal, well-known actor, has devised the novel color chart seen in the photograph Resembling a cross-word puzzle in colors, the musical chart provides an individual tint for each key and note. By following the color guide, a pianist can tell at a glance what notes to play in the key of B, for example, when his music is written in the key of F. It is expected to be of special help to students.



VERSATILE DRAWINGBOARD

TABLE, chair, and drawing easel are combined in the novel piece of furniture shown at the right. Adjustable to any desired angle, the drawing board can be raised for use as an upright easel or lowered to table height. The versatile fixture is equipped with casters, and can also be converted into a tea wagon, a small hand truck, or a cot. Handles on the clamp nuts make the various adjustments easy.

TRUCK HOLDS BIGGEST SEARCHLIGHT

BELIEVED to be the largest of its type in the world, a giant searchlight mounted on a truck has been constructed from plans made by a California lighting expert. Rated at 1,000,000 candle power, the huge lamp casts a beam said to be visible at a distance of 100 miles. Current is supplied by a gasoline-motor generator mounted on the truck chassis. The size of the lamp is shown by the two girls who are standing inside its huge reflector. Its truck mounting allows the light to be taken wherever it is needed.

PIPE HAS CORNCOB CORE

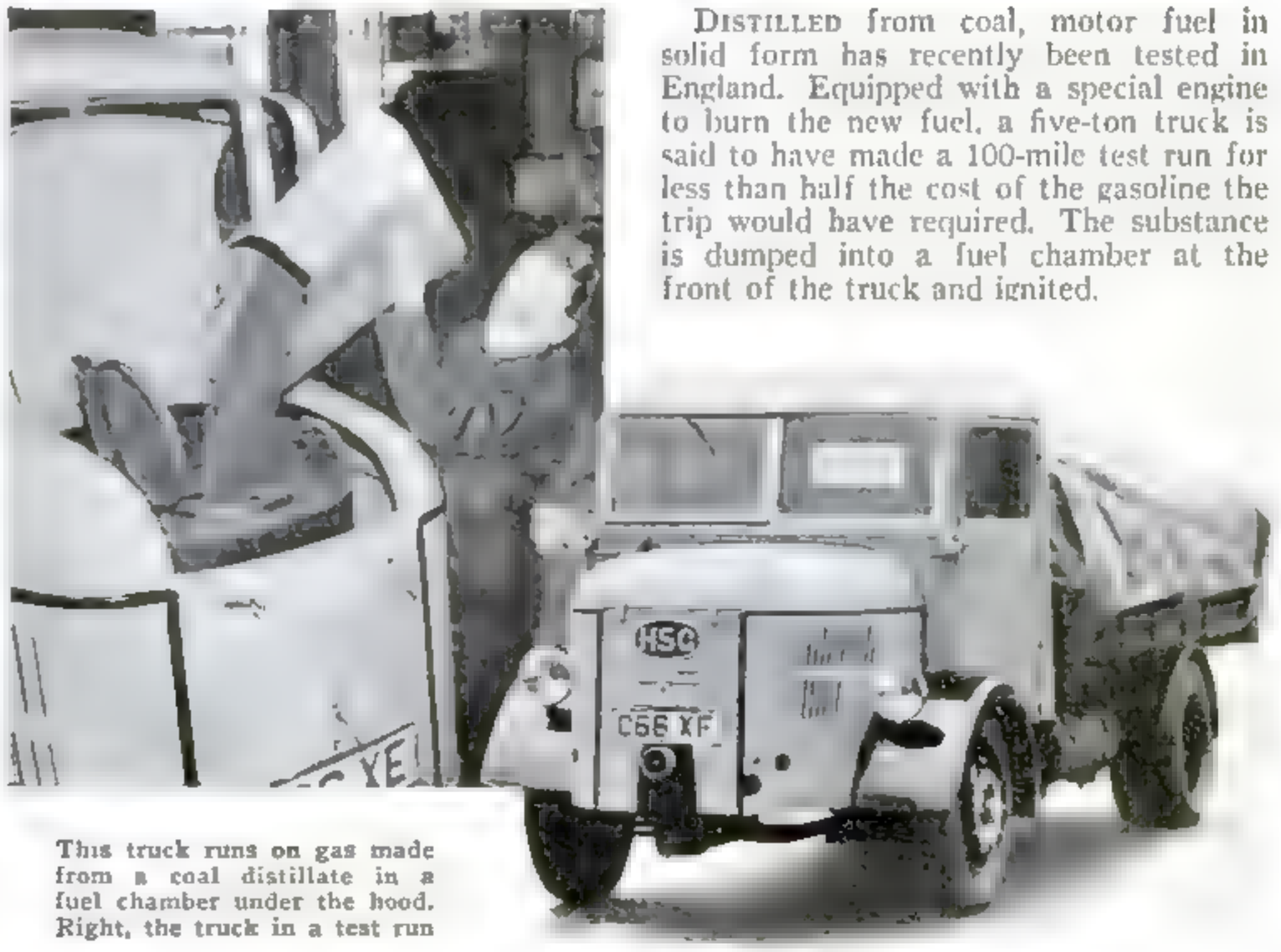
WHEN the corncob bowl of a new underslung pipe becomes too "rich" for pleasant smoking, it can easily be replaced with a new one. Stem and outside bowl of the pipe are made of a composition material. The base of the pipe bowl unscrews, allowing the corncob lining to be changed.

VITAMINS IN SPAGHETTI

SPAGHETTI containing vitamins has been produced at the Moscow Vitamin Institute as the latest device for improving the Russian diet. Vitamin candy is already being manufactured on a large scale.

SOLID AUTO FUEL IS MADE FROM COAL

DISTILLED from coal, motor fuel in solid form has recently been tested in England. Equipped with a special engine to burn the new fuel, a five-ton truck is said to have made a 100-mile test run for less than half the cost of the gasoline the trip would have required. The substance is dumped into a fuel chamber at the front of the truck and ignited.



This truck runs on gas made from a coal distillate in a fuel chamber under the hood. Right, the truck in a test run

THE WAY WE

That There Is No Such Thing as "Correct Posture" Is the Decision Reached by Modern Men of Science After Tests Which Upset Old Ideas on the Subject

"STAND right and be healthy!" From early youth to middle age, we have that advice drummed into our stubborn heads.

"Stand up straight, Junior!" says the proud father to his young hopeful.

"Sit up straight, children!" orders the schoolmarm.

"Stick out your chests and pull in your stomachs!" the gym teacher tells his class.

"Assume the position of the soldier," the drillmaster commands his squad. "Knees straight without stiffness. Hips level and drawn back slightly. Body erect and resting equally on the hips. Chest lifted and arched. Shoulders square. Head erect. Chin in. Eyes to the front!"

"Keep the back of your neck against your collar!" the leader of the business men's keep-fit class advises his perspiring victims.

And we do it—while we are being watched.

But the moment that we are free to do as we please, most of us fall back into the more or less faulty posture that habit or our individual physical conformation makes most comfortable for us. We let our shoulders droop. We allow our abdomens to stick out and our chests to sag in. We fail to keep our chins up and tucked in nicely. We grow intent on our work and slouch over our desks or benches.

Now, a thorough and scientific study of posture has shown that the drillmasters and the gymnasium teachers have been wrong—that there is no such thing as a "correct" posture for people of all ages and all builds. And another recent investigation into the relation between posture and health has shown that people whose postures are graded "poor" are just as healthy and just as strong as people whose postures are "good."

Like a lot of other things, good posture looks well, but it is far from being a vital necessity!

Since the dawn of history, a great majority of mankind has been standing "incorrectly."

One of the two sculptured gentlemen pictured on these pages is more than 1,500 years older than the other. Yet they are standing pretty much alike—and standing in postures that, while they aren't really bad, wouldn't arouse any great admiration among the delegates to a physical-education convention.

One of them, at the left, is the Idolino, a bronze figure representing the fifth-century, B. C., Greek ideal of what the male human body should be. The other is "The Average

The position of the soldier, as exemplified by its foremost exponent, the West Point cadet corps. Yet, as the picture below shows, a cadet relaxes off duty

The ancient Greek ideal of physical perfection, as represented by the Idolino, a statue made in the fifth century B.C. According to the popular idea, his posture is incorrect

Photo Courtesy Metropolitan Museum of Art

By ARTHUR GRAHAME

STAND

American," the sculptured, scientific composite of 100,000 American soldiers measured and weighed before their release from service in the World War.

Compared with the "attention" position of the Military Academy cadet also pictured, their postures aren't impressive. But they are far more natural, and much better adapted to the conditions of everyday life under which we work and play. Even West Pointers, when off parade, relax from the "ideal" posture that they are trained to assume for the purposes of military pomp and circumstance.

In fact, it is very doubtful if the "attention" position of the soldier is ideal for anything but impressiveness on the parade ground. Robert J. H. Kiphuth, assistant professor of physical education at Yale University, who, with Dr. Winthrop Morgan Phelps, professor of orthopedic surgery at the same institution, has made an exhaustive study of posture and postural defects, thinks that the influence of military drill on American posture has been more bad than good.

"Our usual idea of correct posture," he told me recently, "was derived from the military ideal—the 'position of the soldier.' That position is extremely artificial. The chest is lifted and the chin retracted, which results in abdominal stretch and strain of the lower back. The knees are 'back-set', and the feet turned out uncomfortably at an angle of forty-five degrees. This position is so fatiguing that it can be maintained only during a military drill or a gymnastic lesson. Even if it were scientifically correct—which it is far from being—it wouldn't be practical for ordinary life."

Popular interest in competitive athletics also has played a part, according to Prof. Kiphuth, in the formation of faulty ideas of what constitutes good posture. An athlete may be able to sprint a hundred yards in record time, or win his varsity letter at football or rowing, and yet be a decidedly poor model to follow for posture. Some of our greatest athletes have very obvious postural defects.

With many men of the heavily built athletic type—the sort of men who make football linemen—the shoulders are carried too far forward. This is caused by the marked overdevelopment of their pectoral muscles and of all the muscles about their shoulders, with a resulting muscle-binding of the entire shoulder girdle. These men look round-shouldered, and their necks seem unduly short.

"Is there any accepted 'correct' posture?" I asked Prof. Kiphuth.

"There can be no standard 'correct' posture for people of all ages and all kinds," he replied.

"Many people think that a flat abdomen is one of the requisites of good posture. It is—but only during the young-adult period of life. The normal posture of young children includes a prominent abdomen, and this prominent abdomen usually is the last physical characteristic of childhood to disappear. But as a man approaches middle age his abdomen becomes prominent again, and a flat abdomen is a real rarity after the age of thirty-five has been attained.

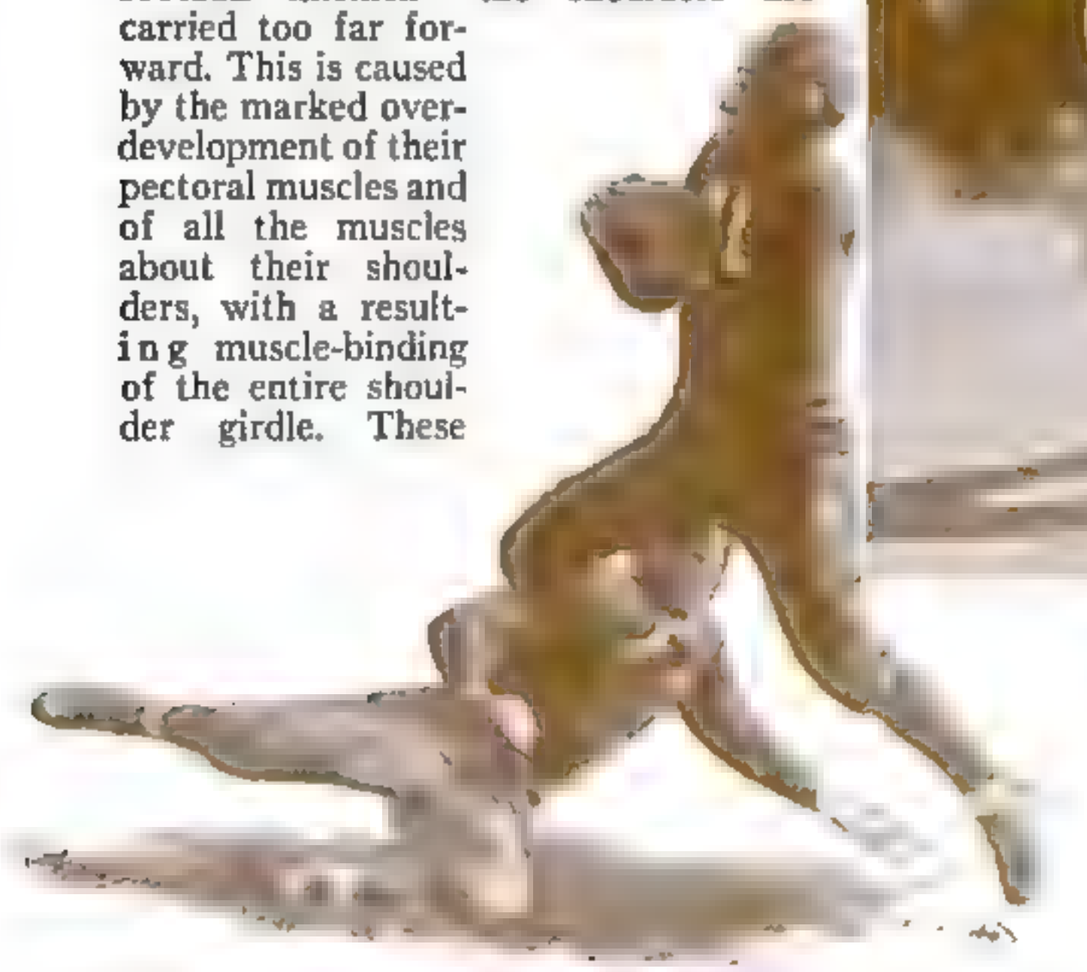
"There is, of course, an 'ideal' posture. It is a matter of perfect bone, joint, and muscle alignment. The feet are parallel with each other, and the knees are straight. In the young adult, both upper and lower spine are flat, the chest is moderately elevated, and the abdomen is flat. The neck is perpendicular.

"That's the 'ideal' posture—but it is a posture that is seldom seen except among those who have received scientific postural training.

"Every freshman here at Yale receives a postural examination. Most of them are given corrective physical exercises to remedy defects. A good many thousands of these postural examinations have made it possible for us to arrive at the 'normal,' or average, posture of young men. It differs a good deal from the ideal posture. The position of the feet and knees are the same, but the lower part of the spine is slightly concave, and the upper part of the spine is slightly convex. The spine also has a slight curvature to the left. The neck is inclined slightly forward. The chest is slightly depressed, and the abdomen slightly protruding. Whether we like it or not, that's the way that the majority of our young men stand."

To determine what relation exists between posture and health, and between posture and strength, and to find out how people really stand, U. S. Public Health Service surgeons, working under the direction of Assistant Surgeon-General Lewis R. Thompson, have completed a study of 2,200 normally healthy boys and men of American parentage, ranging in age from two and one half to seventy years. The adults of this group follow varied callings, and include accountants, bankers, clerks, *(Continued on page 122)*

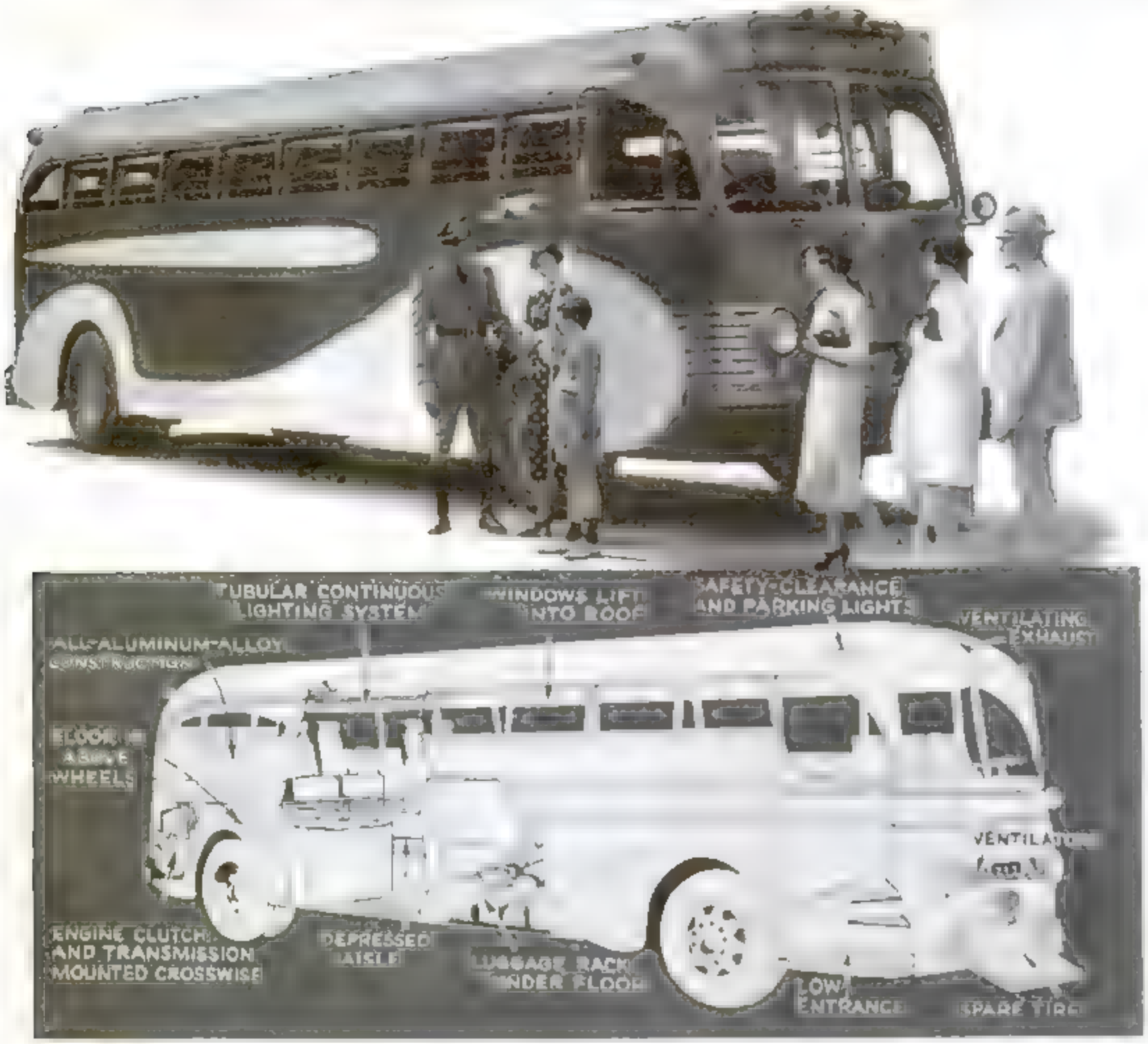
How the average American stands: A composite statue of 100,000 soldiers in our World War army. A natural pose, if not "correct"



THEY CAN'T TEACH HIM ANYTHING ABOUT IT

A child just learning to walk has a perfectly natural posture, according to scientists. Men of the heavily built athletic type, such as football linemen, often appear stoop-shouldered

PASSENGERS RIDE HIGH IN NEW-TYPE STREAMLINE BUS



RADICAL new features are embodied in streamline motor busses recently placed in service on western lines. Entering one of these vehicles, a passenger steps up from a sunken aisle to his seat on an elevated passenger deck. Its height above the road minimizes dust, avoids interference with leg room from wheel housings, and gives the traveler an unobstructed view of the scenery over the tops of other cars on the road. The arrangement also eliminates overhead luggage racks and the attendant inconvenience of stowing away and retrieving heavy suitcases, by making room for a commodious baggage compartment beneath the floor. Bags are placed in this compartment and removed through four large doors in the exterior of the body. Special compartments are provided for the hats and coats of passengers above the deeply cushioned seats and within easy reach. A tubular lighting fixture running the length of the interior, at the middle of the ceiling, adds a decorative touch.

From the exterior, the new busses also present an unconventional appearance. The thirty-six-passenger machines are blunt-nosed, the engine being placed at the rear to afford the driver better vision and to keep out exhaust fumes.

SELF-SOAPING CLOTH IS AID TO TRAVELERS

A NOVEL wash cloth that contains its own soap provides motorists and other travelers with a handy means of cleaning up at out-of-the-way stops, since copious suds are produced merely by wetting the cloth and rubbing. Its coconut-oil lather is also declared well suited for home use as a shampoo.

RATS GET AIR-CONDITIONED QUARTERS

AIR-CONDITIONED homes for white rats are a novel feature of experiments being conducted at the Wistar Institute of the University of Pennsylvania. The Institute, which has sent colonies of rats all over the world, breeds the rodents for experimental purposes and notes their development under rigidly controlled conditions of diet and environment. Check is kept on the weight and health of the rats, and selected groups are then made available to other investigators. Fourteen cows supply milk for the 8,000 rats under observation. The homes utilized in these experiments are believed to be the only air-conditioned living quarters in the world designed specially for rats.

A technician weighing one of the 8,000 white rats bred for experimental purposes at the University of Pennsylvania

DESIGNS FIVE-TOED SHOE THAT FITS LIKE A GLOVE

RESEMBLING a glove, with its five fingers, a unique shoe recently displayed at a convention of osteopaths provides a separate compartment for each toe of the foot. Greater comfort is claimed for the novel footwear by its designer, a practicing osteopath who believes that the construction of the human foot is such that individual sections for the toes permit a flexing, cushioning action impossible in the more cramped quarters of the normal, one-sectioned shoe.

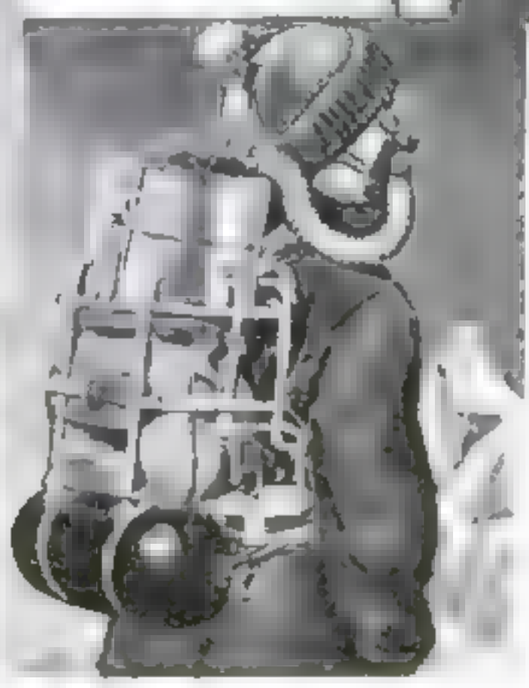
Novel five-toed shoe designed by an osteopath as compared with a conventional shoe

NEW OXYGEN MASKS AID EXPLORERS TO REACH DIFFICULT GOALS

An aviator equipped with an oxygen mask for use in an altitude flight

Helmet and suit made for a stratosphere balloonist. The tanks supply the oxygen

Oxygen is mixed with atmospheric air in this outfit designed for mountaineering



Another type of equipment for climbers. It furnishes pure oxygen, and holds a five-hour supply

MOUNTAIN CLIMBERS have now joined the ranks of those who carry their own air with them. Portable oxygen tanks, tried out by recent expeditions in the rarefied atmosphere of lofty peaks, are proving a new aid in reaching record heights.

How ingeniously inventors have contrived to enable men to breathe, in the face of seemingly insuperable physical obstacles, is shown by the variety of uses to which oxygen apparatus has been adapted. Manufacturing their own atmosphere as they go, explorers have risen in stratosphere-balloon gondolas thirteen miles above the earth, and have descended in steel spheres 3,000 feet beneath the surface of the sea. Divers, seeking treasure at unheard-of depths where terrific water pressure would crush air hoses, have been sustained with life-giving whiffs of oxygen from flasks built into their armored suits. A Japanese dare-devil put an oxygen mask to probably the strangest use yet recorded when he allowed himself to be lowered a quarter of a mile into the crater of an active volcano, the equipment protecting him from the lethal fumes that billowed up from the inferno below.

Oxygen masks developed within the last few months for mountaineers set a new mark in compactness and efficiency. Every possible ounce of weight has been pared to make them less burdensome. Two types, as shown above, have been tested recently by daring explorers.

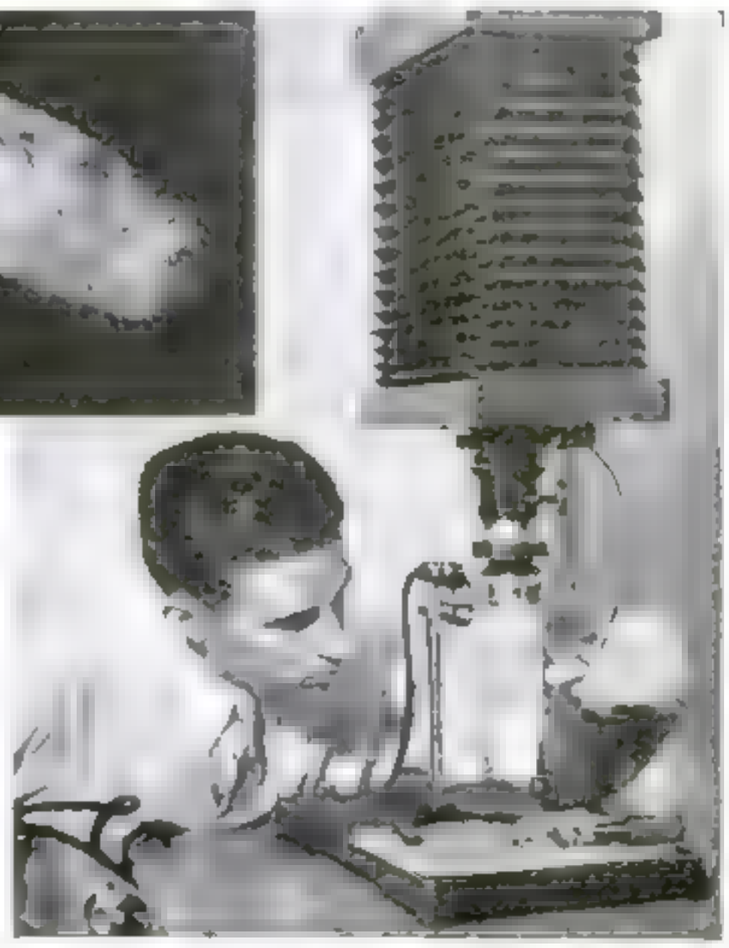
RADIO PATROL CAR IS ALSO AN AMBULANCE

ANSWERING an emergency call, a radio "cruiser" just placed in service by police of Parma, Ohio, is prepared either to battle crooks or to rush accident victims to a hospital, for it constitutes a patrol car and ambulance in one. A stretcher and runway are carried folded within a trunk at the rear of the car, and may be unslung for use in a jiffy. The photograph shows a recent demonstration of the new equipment.

CHEMICALS MAKE FINGERPRINTS GLOW

ODD chemicals that "fluoresce," or glow in the dark, under the invisible rays of ultra-violet light, have been pressed into service by criminologists to reveal fingerprints where other methods fail. Standard technique has been to dust a suspected print with a powder that adheres to its oily traces, making it plainly visible if a coating can be found that contrasts in shade with the background. This has been impossible when the background was a mottled pattern of black and white or of colors. In a process devised by Fletcher Gould, photographer for the Pasadena, Calif., police department, a fluorescent chemical powder such as uranyl phosphate or anthracene is used to coat the finger mark. When the exhibit is photographed under an ultra-violet lamp, the troublesome background disappears and the luminous fingerprint stands out in glowing lines. The fluorescent materials are mixed into dusting powders of various colors, to give best results on backgrounds of all kinds.

A fingerprint photographed by means of fluorescent salts



Right, Fletcher Gould, inventor of the process, making pictures of prints on a mottled surface

Huge Star Cameras To Make Atlas of the Heavens

USING a 2½-ton battery of astronomical cameras, G. W. Cook, Philadelphia amateur astronomer, plans to make a photographic atlas of the heavens. The equipment comprises a cluster of three cameras, the largest of which utilizes photographic plates almost two feet square. After completing the task of "shooting" the stars visible in the Northern Hemisphere, Cook plans to move his apparatus to South Africa to photograph the southern sky. A guiding telescope fitted with a four-inch lens is used to aim the cameras and to check the operation of an electric motor which automatically turns the apparatus so that it can be kept in time with the rotation of the earth.

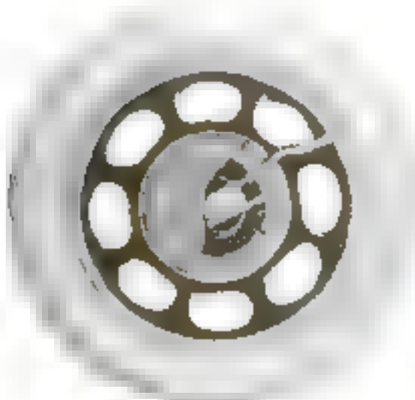
G. W. Cook, amateur astronomer, examining the huge photographic apparatus he will use in making pictorial maps of the starry sky

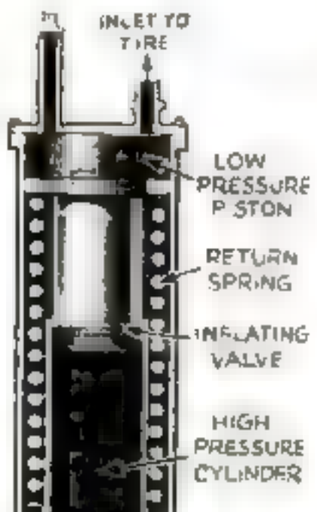
FIND ANCIENT DOUBLE FOR RODIN'S "THINKER"

FASHIONED more than 800 years ago by an aboriginal artist of Mexico, a small pottery figure bears a startling resemblance to Rodin's world-famous statue, "The Thinker," left, first shown in 1904. The Mexican piece was discovered among Indian ruins in the state of Jalisco, and is now on exhibition at the Field Museum of Natural History, Chicago.

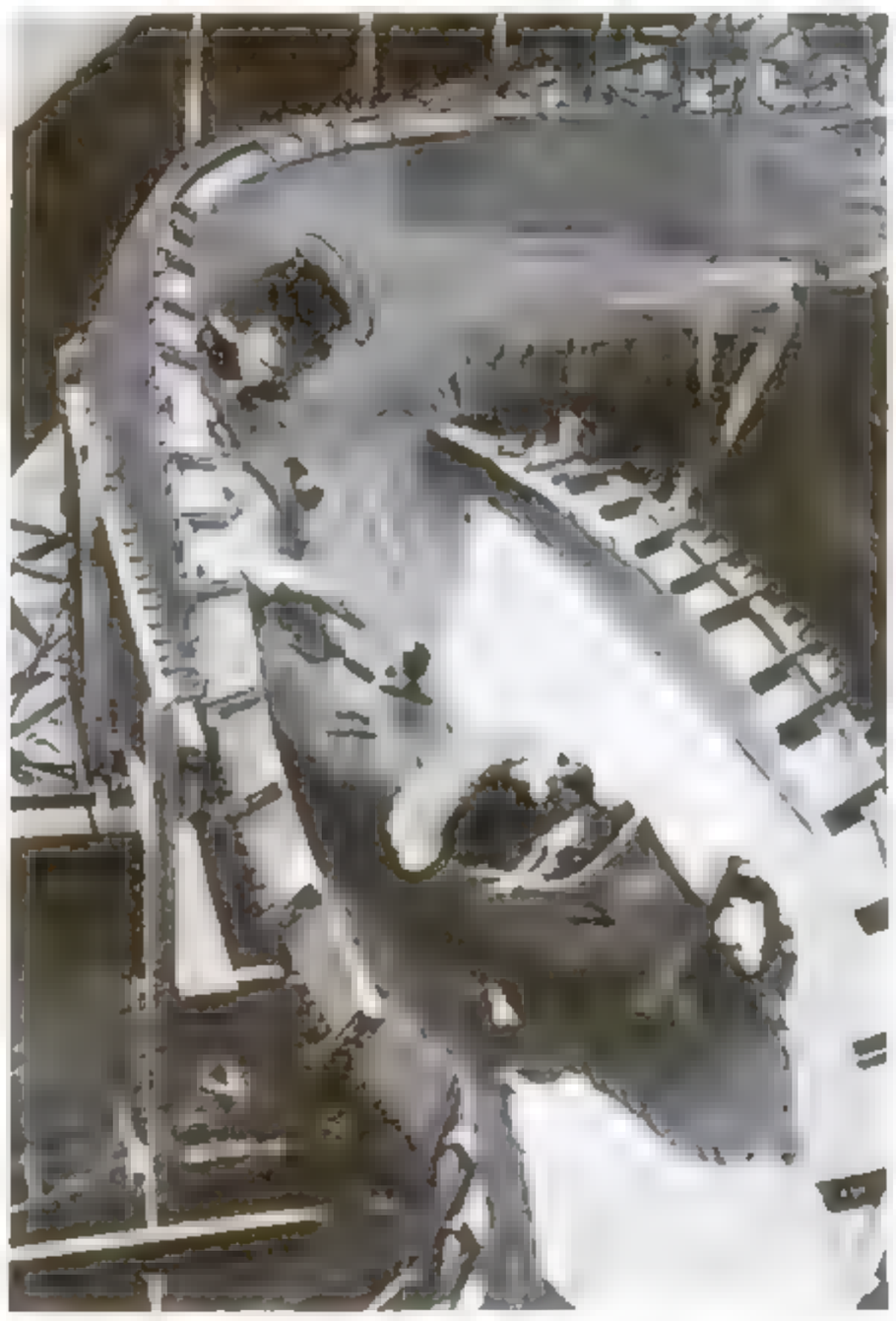
HUB-CAP PUMP KEEPS AUTO TIRE INFLATED

BUMPS in the road are utilized to keep automobile tires at normal pressure, with a hub-cap pump recently devised. When the pressure falls below a predetermined point, a spring control allows the abnormal tire pressure created by irregularities in the road to move a piston in a low-pressure cylinder. This in turn drives a smaller piston which serves to build up the air pressure in a high-pressure cylinder to a point where it is forced back through valves into the tire.





Novel auto-tire pump in hub of wheel and, right, diagram showing how it keeps up air pressure



WHEELED BOBSLEDS USE WOOD RUNWAY FOR THRILL RIDE

HURTLING down a wooden run on a wheeled vehicle resembling a bobsled is a new attraction for visitors to an amusement park in Berlin, Germany. Twisting and curling into steep horseshoe turns and sharp curves, the novel roller-coaster surface is a warm-weather counterpart for the steep, icy runs built for winter bobsled races. Each rolling "bobsled" is made up of loosely jointed sections that whip sideways as the odd craft swerves down and around the breath-taking course.

INSECTS SURVIVE YEAR-LONG FAST

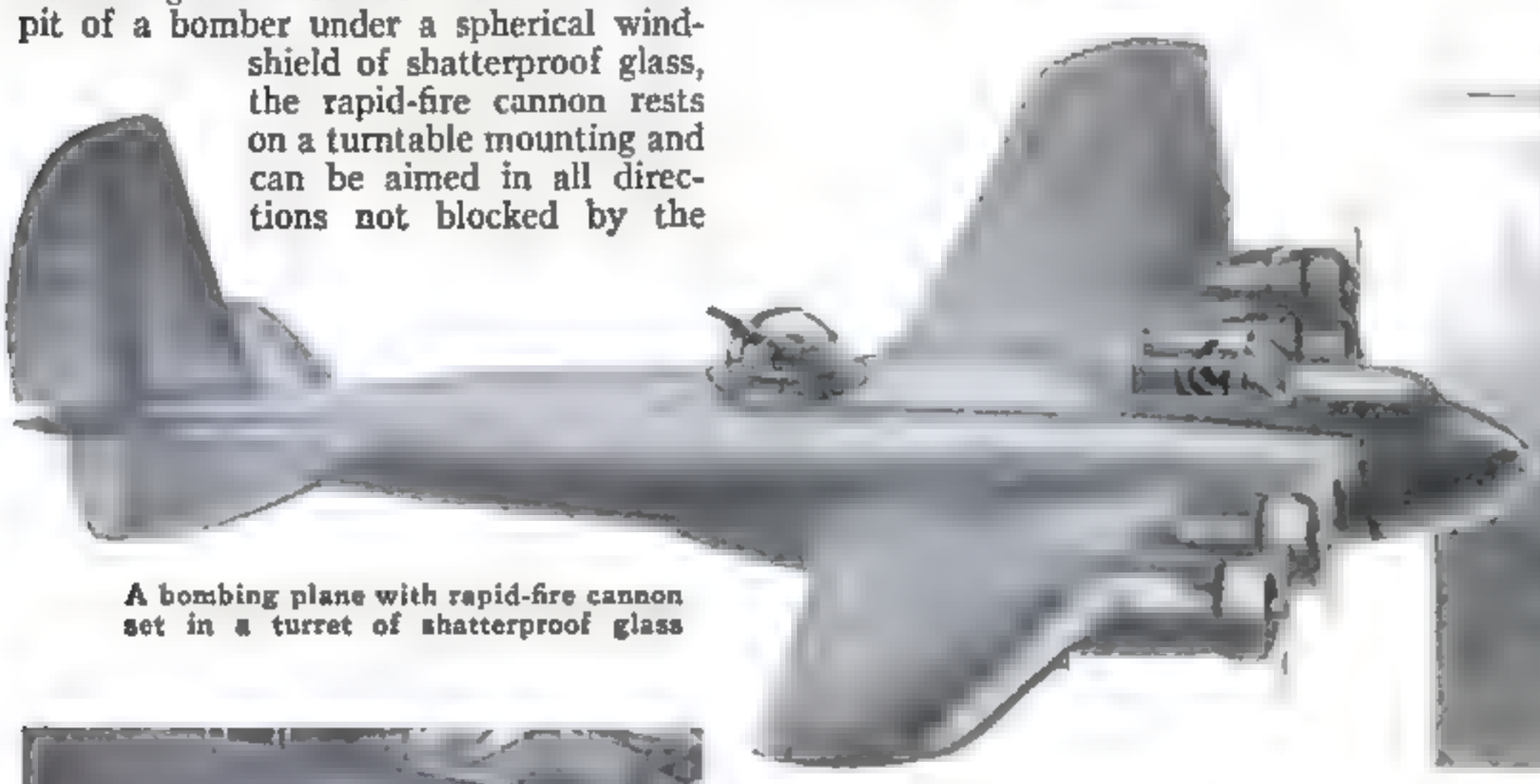
BEDBUGS were kept alive and fairly active for a year without food, in a test conducted recently by the American Institute of Sanitation to determine the endurance powers of insects.

BUILDS TINY AUTO MODEL INSIDE BOTTLE

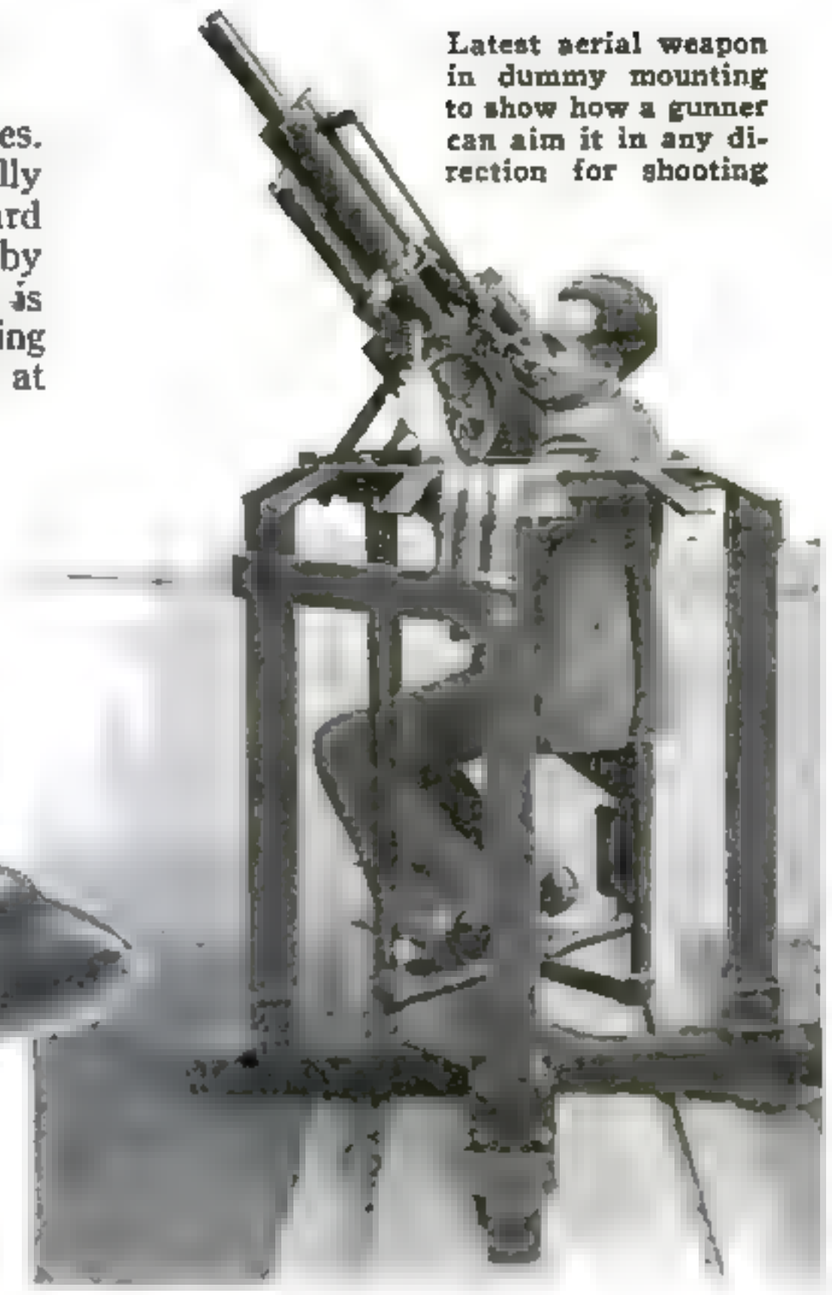
A NOVEL automobile model, pictured at the right, was assembled piece by piece inside a medicine bottle. Built by a Philadelphia, Pa., model maker, the diminutive car was constructed from cigar-box wood and bits of old furniture. The bottle itself is supported in a horizontal position by a wooden frame.

WAR PLANES GET RAPID-FIRE CANNON

CALLED the most powerful aerial weapon ever devised, a new aircraft cannon fires one-pound, high-explosive shells at the rate of 100 a minute. Designed for use in bombing planes, the gun has a special recoil mechanism to absorb shock, and is said to have an effective range of 1,000 yards, far greater than that of airplane machine guns. Installed in the rear cockpit of a bomber under a spherical windshield of shatterproof glass, the rapid-fire cannon rests on a turntable mounting and can be aimed in all directions not blocked by the plane's fuselage, wings, and tail surfaces. Armored enemy planes that are practically invulnerable to the attacks of standard machine guns would be blown to bits by one shell from the aircraft cannon, it is claimed. The gun is capable of handling projectiles that can be set to go off at any predetermined distance.



A bombing plane with rapid-fire cannon set in a turret of shatterproof glass



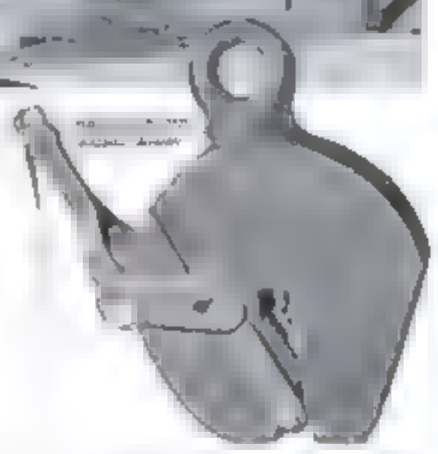
Latest aerial weapon in dummy mounting to show how a gunner can aim it in any direction for shooting

SAILS MAKE HUMAN YACHTS OF BATHERS

BATHERS become human yachts as they lie on flat surf boards fitted with masts and sails in a new water sport gaining popularity at seacoast resorts in England. The swimmer stretches out face upward on the board, straddles the diminutive mast, and steers the odd sailing craft by moving the arms and hands. The position of the mainsail is controlled with the legs and feet. In a good breeze the sailboats skim along at a surprising speed.

Bathers lined up for a race on surf boards fitted with masts and sails

Above, circle indicates mechanical gripper attached to a hoist. Close-up at right shows how sliding bars close slot to provide sure grip on steel plates



MECHANICAL CLAW GRIPS HEAVY STEEL PLATES

A NEW mechanical gripping device is used with hoisting engines in lifting steel plates, bars, girders, and other structural members. If a steel plate is to be hoisted, one edge is placed within the open throat of the gripper, and slanting bars slide down a slot to hold the object in a strong, positive grip. Since the downward pressure of the steel plate is exerted directly against the sliding bars, the heavier the lifted object is, the tighter the bars clamp it into the throat of the mechanism. When the load has been landed and the strain released, a slight pull on a control lever raises the bars and frees the gripped plate. Heavy loads can thus be lifted in safety.

SPECIAL GLASS PROTECTS DOCUMENTS

"Document glass" in this case guards old manuscripts against sunlight

RARE manuscripts and papers are now exhibited by the New York Historical Society in a case covered with "document glass," a new development which filters out the ultra-violet light rays that cause paper to deteriorate and fade. Although it blocks all harmful light rays, the new glass is said to be perfectly clear and transparent. "Document glass," it is stated, will make it possible to display valuable records and manuscripts that were previously kept from public view.

Man-Made Oases Save Desert Birds

Waste lands are turned into hunting grounds by improving nature's scanty water supply

By JOHN EDWIN HOGG

USING paddle-wheel windmills, dynamite, and automatic siphons, conservation experts are developing game-bird oases in the deserts of the far Southwest. By opening up wells and springs, they are making possible a new hunting ground for American sportsmen.

During the last half dozen years, nearly 6,000 square miles of such waste-land preserves have been created in California. Pioneer work was carried on by clubs, sportsmen's organizations, and ranchers interested in game-bird propagation. Now, the State Department of Natural Resources is coöperating in the movement. Eventually, hundreds of thousands of square miles of arid land in Texas, Arizona, Nevada, New Mexico, Utah, Idaho, and other western states may be used for producing game birds.

Experiments have shown that even a small amount of water will enable doves, quail, sage hens, pheasants, and Chukar partridges, a game bird imported from the desert regions of Persia, to live and multiply. A spring or well yielding as little as ten gallons of water a week will produce a game-bird oasis fifty miles in diameter.

Scattered through the Southwestern deserts are literally hundreds of small springs that flow for five or six months a year and dry up the rest of the time. By sinking a shaft ten or fifteen feet, setting off a few sticks of dynamite, and mucking out the hole, many of these springs can be made to flow permanently. A rill running from such a spring into a natural storage basin below makes an ideal watering place for desert birds.

To conserve every drop of the precious water, an ingenious flow regulator has been installed at several of the springs. A pipe, with a brass screen over the intake, is inserted in the spring, which is then filled with coarse gravel. Curving downward to a trough below, the pipe acts as a siphon, draining the water from the spring. When the trough is full, a valve connected with a ball float automatically cuts off the flow, permitting it to start again when the level of the water sinks.

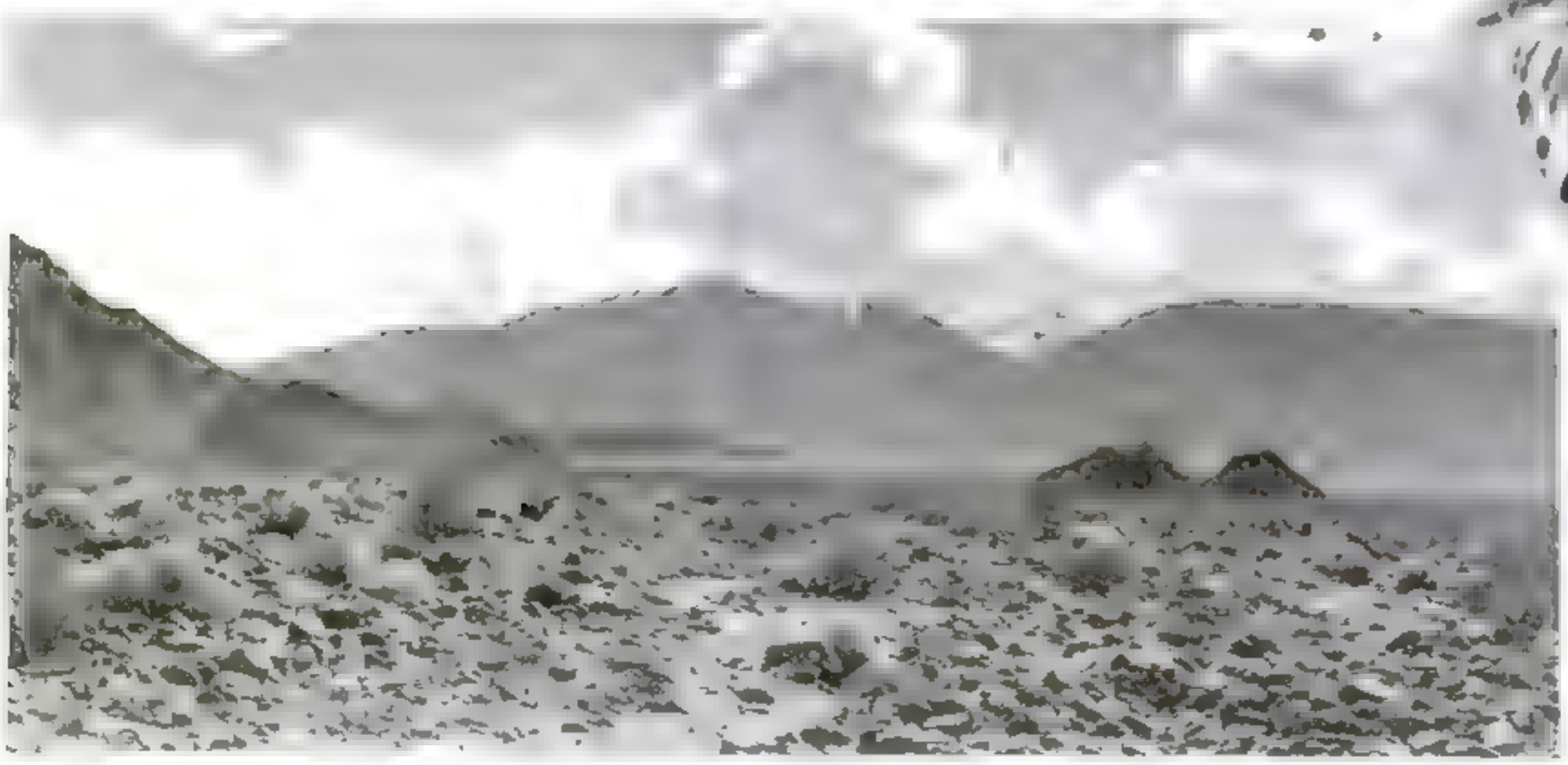
Facing into the prevailing desert wind, this paddle-wheel windmill lifts water from a fifteen-foot well by means of a bucket-type conveyor belt to fill a near-by drinking trough for birds

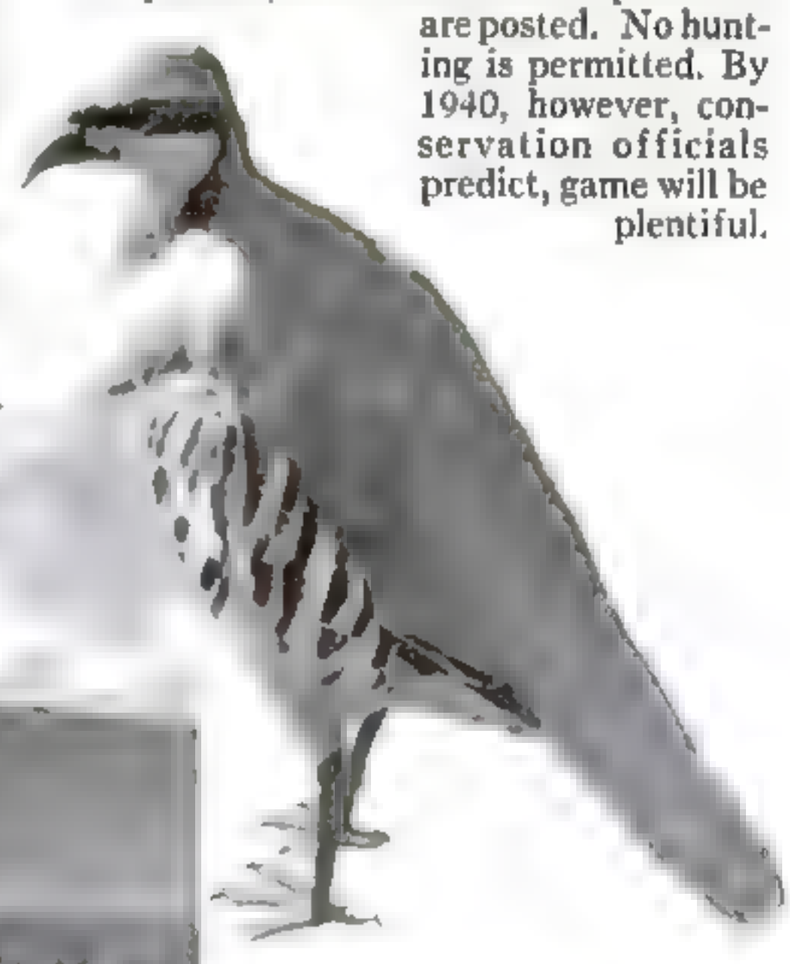
Imagine constructing a concrete dam to hold back water in the middle of a desert! That is what is being done in a number of arid canyons in southern California. They are designed to duplicate natural "desert tanks," rocky depressions where water flows in but cannot flow out during infrequent rains or cloud-bursts. One artificial "tank" in Riverside County, Calif., collects a supply of water that lasts from six to ten months and provides drinking water for nearly 6,000 game birds. The dam cost only $100. Three times this desert pool has saved the lives of travelers dying of thirst.

To keep the water sweet and pure in such ponds, scientists have turned to lessons learned in aquariums. Trapdoor snails from Japan, tadpoles, minnows, crayfish, and oxygen-generating plants have been introduced to destroy refuse and keep the water fresh.

Where it is impossible to develop "tanks" or springs, sometimes wells tap underground sources of water. Curious windmills that suggest paddle wheels on Mississippi steamers, have been brought into use at several of the wells. Facing the prevailing desert wind, they operate plunger pumps or bucket-type conveyor belts.

At present, all of these desert preserves are posted. No hunting is permitted. By 1940, however, conservation officials predict, game will be plentiful.

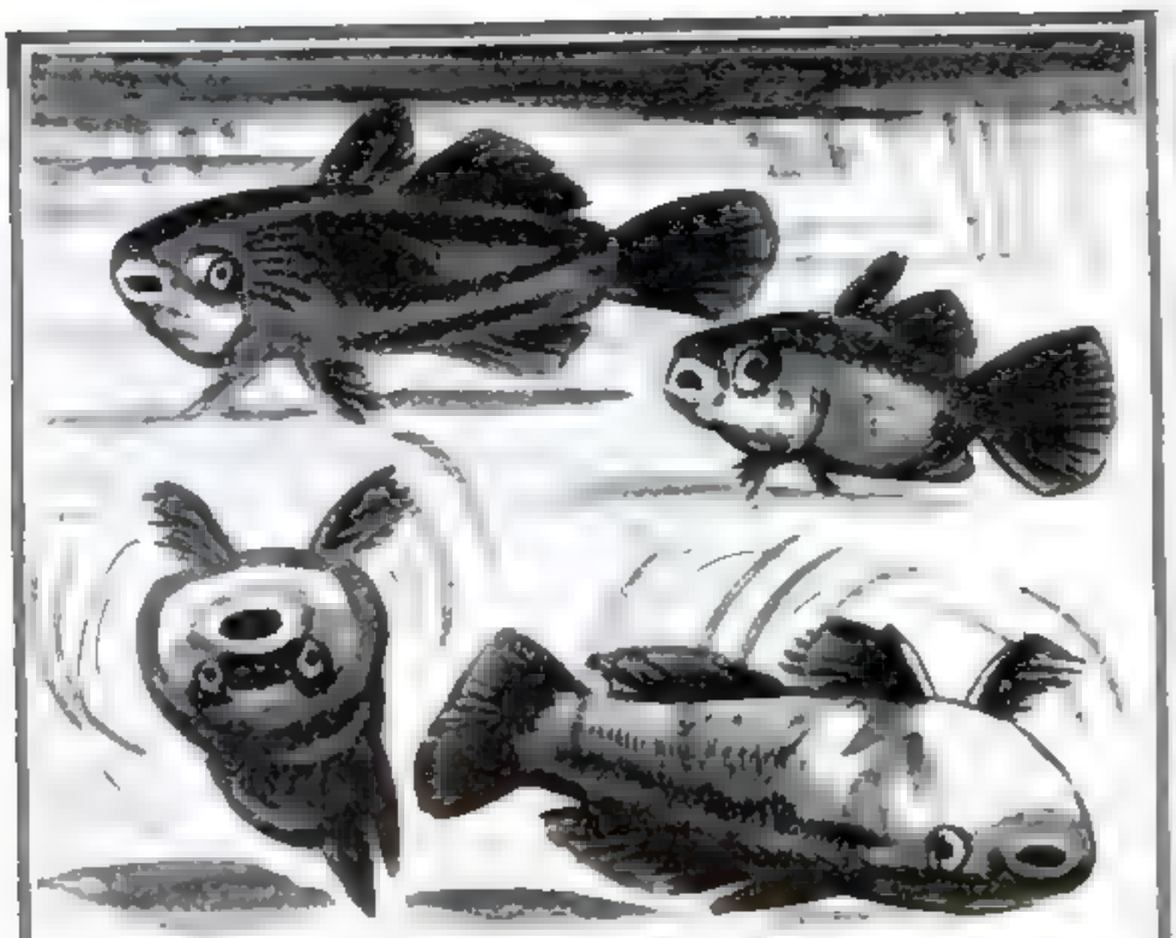




A Chukar partridge, a game bird introduced from the arid plains of Persia. Left, a view of the Avawatz Range from Death Valley, showing the mountain snows that feed the springs of the desert

Un-Natural History

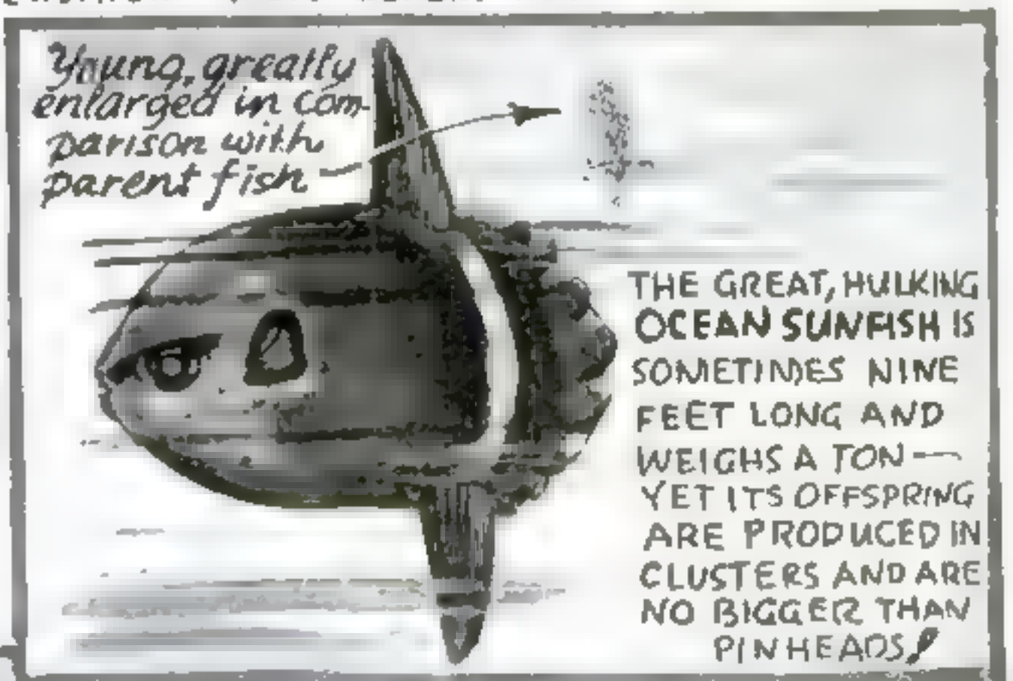
By GUS MAGER



FAINTING FISH—CAPTIVITY MAKES NERVOUS WRECKS OF GOBIES. WHENEVER ANYONE MAKES A SUDDEN MOVEMENT IN FRONT OF THEIR TANK, THESE POOR FISH FALL OVER IN A DEAD FAINT. SOMETIMES, IT IS SAID, THEY EVEN DIE OF FRIGHT!

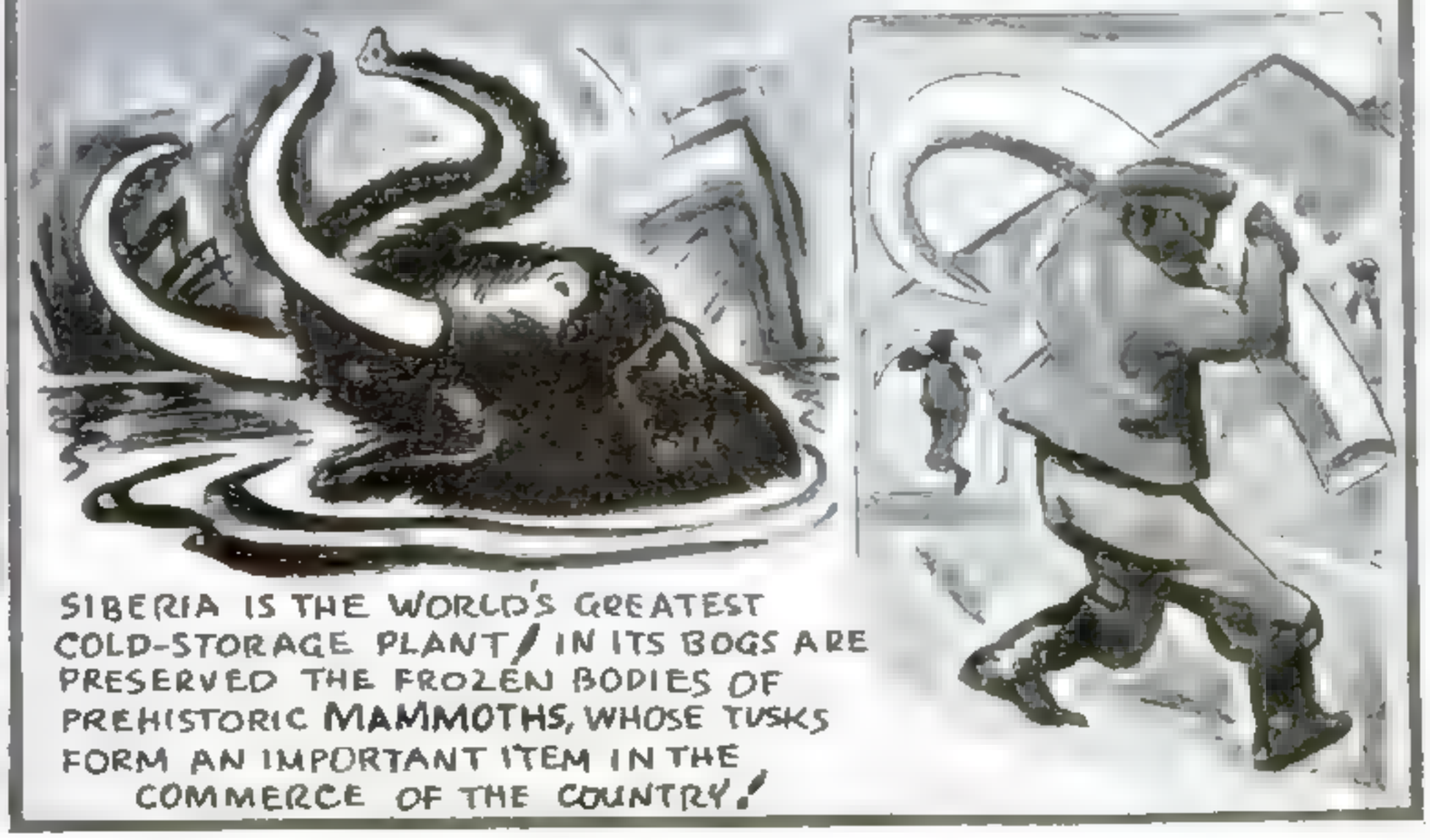
THE **PORCUPINE TREE** (ACROCOMIA PALM) OF SOUTH AMERICA AND THE WEST INDIES BEARS LONG, NEEDLE-SHARP SPINES THAT BREAK OFF IF BRUSHED AGAINST, AND FESTER IN THE FLESH. AS THE STATELY PIN-CUSHIONS GROW OLDER, THEY SHED THEIR NEEDLES

SOME TONGUE-LASHING THE **SPHINX MOTH** CAN DISH OUT! IT SPORTS A A HOSELIKE TONGUE THAT IS TWICE THE LENGTH OF ITS BODY!



THE GREAT, HULKING **OCEAN SUNFISH** IS SOMETIMES NINE FEET LONG AND WEIGHS A TON — YET ITS OFFSPRING ARE PRODUCED IN CLUSTERS AND ARE NO BIGGER THAN PINHEADS!

BORNEO BOASTS AN **INSECT PARACHUTE**—A TINY PLANTLIKE CREATURE THAT BAILS OUT FROM A TREE BRANCH, USING ITS DOWNY ANTENNAS TO FLOAT IT TO THE GROUND!



SIBERIA IS THE WORLD'S GREATEST COLD-STORAGE PLANT! IN ITS BOGS ARE PRESERVED THE FROZEN BODIES OF PREHISTORIC **MAMMOTHS**, WHOSE TUSKS FORM AN IMPORTANT ITEM IN THE COMMERCE OF THE COUNTRY!

Answers to Common

Here Are Some Questions That Fans Keep On Asking About This Fascinating Hobby. Maybe You Will Find One of Your Own Pet Queries on These Pages

Equipment, supplies, and accessories for an amateur microscope laboratory. As the beginner progresses, he will form ideas of his own as to new items to add to his collection

Right, human blood corpuscles, mostly red ones, as seen under the microscope

To make a slide of blood, a drop can be spread into a film by placing it on a cover glass and sliding another glass over it as shown above

If Canada balsam is too thin for mounting specimens, it can be hardened by warming it over an alcohol or gas flame, or in a water bath

DURING the three years that I have been writing the microscopy articles I have received hundreds of letters from readers asking questions about microscopes and microscope technique. Although these queries cover a wide range of subjects, there is a small group that crop up again and again. Feeling that these are the typical questions that the average amateur microscopist is likely to ask, I decided that it would be a good idea to pass them along together with their answers.

And now for the first question:

I would like to start a microscope laboratory of my own. What equipment should a complete amateur laboratory contain?

EVERY amateur microscopist has his own ideas about the equipment he should possess. However, it is possible to mention a number of items that will be found useful and, in some cases, indispensable. Here they are:

Instruments and glassware: Several small, wide-mouth specimen bottles, with screw caps or corks. One or two wide-mouth glass jars, tumblers, or beakers. A pair of slender-nosed tweezers, preferably of brass or stainless steel. One or more ordinary medicine droppers, with slender or pointed tips. A small, round artist's brush. A pair of shears, such as nail shears. Scalpel or razor blade in holder, for dissecting specimens. A ten-inch piece of glass tubing, for use as a stirring rod and for dipping up small quantities of liquids. One or two saucers, shallow dishes, or watch glasses.

Supplies: A tube of filtered Canada balsam, for mounting specimens. Xylol (xylene), kept in a one-ounce dropper bottle, for dissolving balsam and fatty materials. Ethyl alcohol of various concentrations. You can keep a bottle of absolute alcohol on hand, and dilute it as required. Reagent-grade grain alcohol can be obtained at many drug stores, and denatured alcohol can also be used. Glycerin, pure, in a one-ounce dropper bottle. A one-ounce bottle of orange or white shellac. A one-ounce bottle of gold size, for sealing cover glasses on cells made with the shellac. Various staining solutions, including mercurochrome, iodine, methylene blue, eosin, and haematoxylin.

Other equipment: A quantity of one by three-inch glass slides. A half ounce or so of No. 2 cover glasses, square or round, twenty-two-millimeter diameter. An electric lamp (any type of desk lamp will do). And, of course, a microscope.

These items are among those considered essential by most experienced amateurs. Some can be dispensed with at first; and there are others, such as color filters, that you may consider as necessary even at the beginning of your hobby.

How are permanent slides of blood made? What is the best way of examining human blood?

A SMALL drop of the blood of a frog, chicken, or any other animal can be made into a permanent preparation very quickly and simply. First spread the blood out into a very thin film. One way to do this is to let a drop fall on a clean slide and

Microscope Problems

By MORTON C. WALLING

then, very quickly, draw the edge of a clean cover glass over it. Another method is to drop the blood on a clean cover glass, place a second cover glass over it, and then draw the two apart with a sliding motion, so that very thin films are left on each glass. The blood will dry very quickly.

Various stains can be used to color the blood cells. One of the best is Wright's stain, which can be purchased from dealers. Drop the stain on the dry film. A minute or so later add an equal quantity of water. Then, in another three or four minutes, drain off the water-stain mixture, and add clean water. When pinkish areas appear in the film, drain off the water, and let the film dry for several minutes. Then add a drop of Canada balsam, lay the cover glass in the center of a clean slide, and your preparation is completed.

Blood is particularly beautiful by dark-field illumination. If your microscope is not equipped with a dark-field attachment, you can produce the same effect by inserting a disk of cardboard, somewhat smaller than the substage mirror, between mirror and slide.

Use fresh blood. You can obtain a sample from your own finger. First wash the ball of the finger in a solution of ninety-five percent alcohol and two tenths of one percent mercuric chloride, and then puncture the skin with a needle sterilized in the same solution. A good place to obtain blood is from the middle finger of the left hand. Squeeze until a large drop of blood is obtained. Then touch this drop against a clean cover glass.

Lay the cover glass, blood side down, on a clean slide, and remove any blood that runs out at the edges. Cover the edges of the cover glass with oil—any heavy oil will do—to prevent evaporation.

With dark-field illumination many interesting features of the blood are seen more strikingly. You may even be able to see the white corpuscles moving about like amoebas.

I have some balsam that I use to cement cover glasses in place, but it takes too long to dry. How can I treat it so that it will not be so thin?

EVIDENTLY, the balsam has too much solvent in it. It can be made thicker by evaporating out some of the solvent. This can be done by warming a quantity of the balsam over an alcohol or gas flame, or in a water bath. A drop on a clean slide can be treated easily, when only a small quantity is needed. If the balsam is too thick, it can be thinned with xylol. Use only filtered balsam made specially for microscope work, if best results are desired.

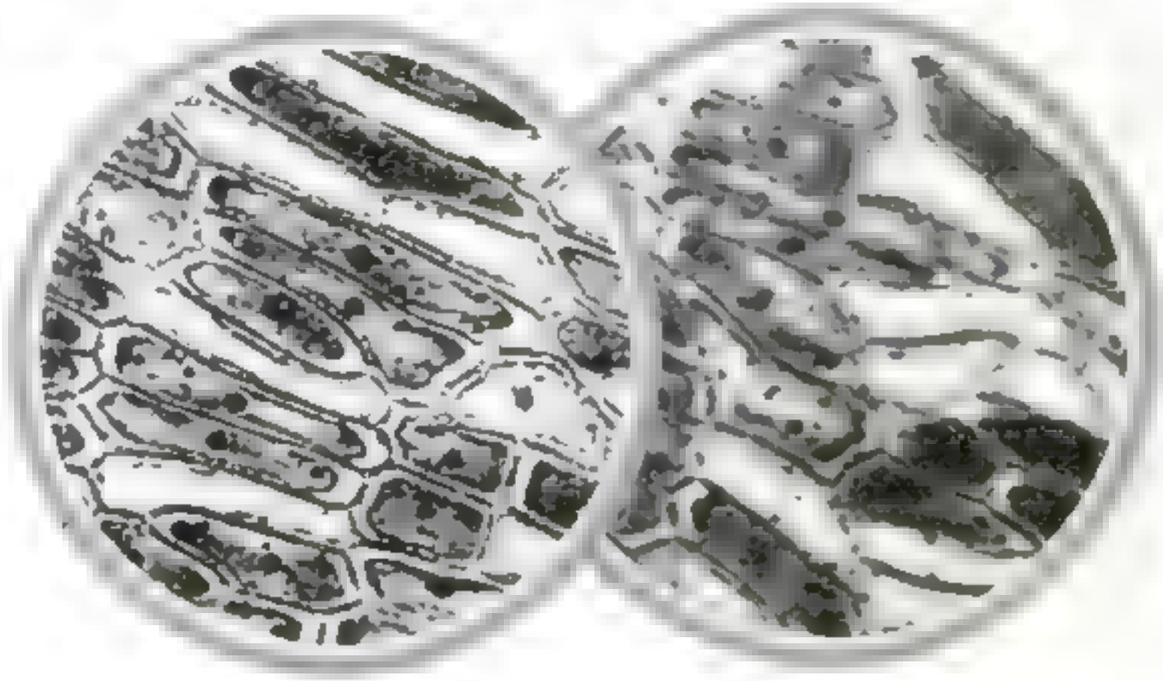
I hear so much talk about oil-immersion lenses. What are they?

MICROSCOPE lenses are rated according to their resolving power, or the ability to separate fine lines or dots very close together. This power depends on, among other things, the index of refraction of the material between lens and object. With an ordinary or "dry" lens, the intervening material is air; and the resolving power therefore is limited by the refractive index of air.

If the refractive index of the material between objective and object can be increased, the resolving

(Continued on page 111)

A typical oil-immersion objective lens of ninety-eight times magnification. It is made for use with the large microscope in the background

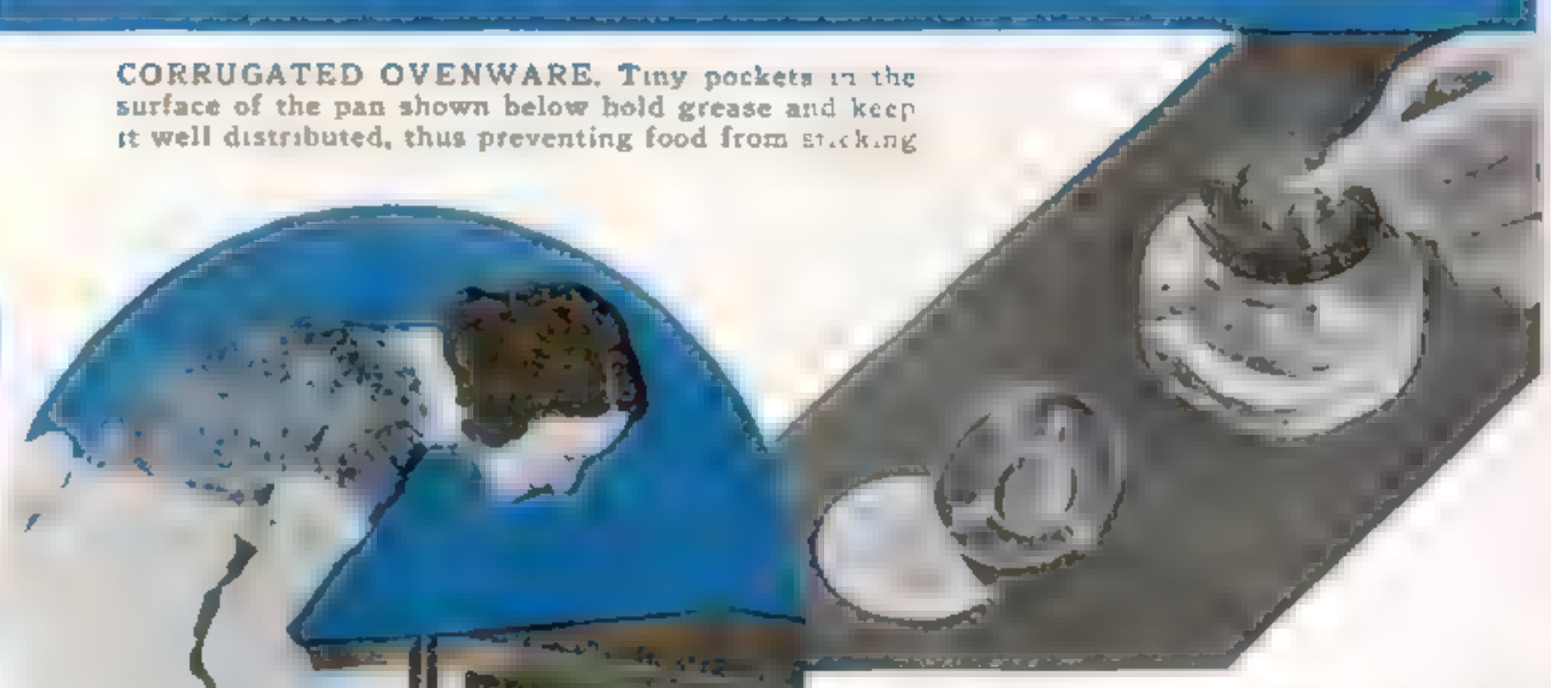


Cells of bean membrane as seen through the well-corrected lenses of a professional microscope (left) and through a cheap, "high-powered" set

Examining coffee for adulterants. Before making such tests, the microscopist must learn to recognize the food itself

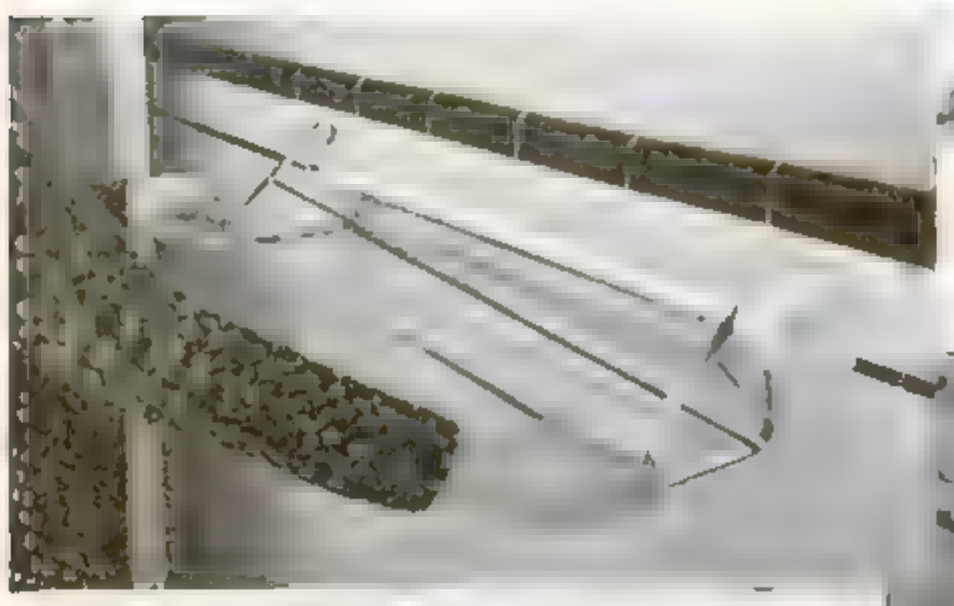
Newest Inventions FOR THE HOUSEHOLD

BAKED BEANS A LA CART. Iron pots containing baked beans, macaroni, or other casserole dishes are served on wooden-handled holders from this wagon



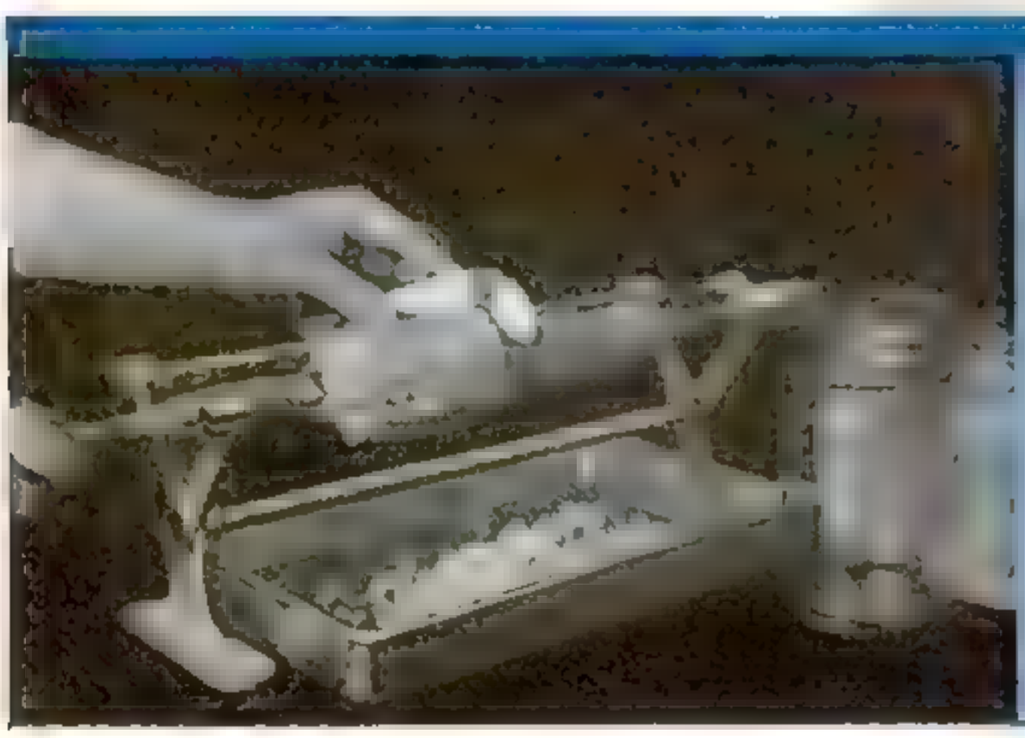
CORRUGATED OVENWARE. Tiny pockets in the surface of the pan shown below hold grease and keep it well distributed, thus preventing food from sticking

FOOD JAR MAKES ASH RECEIVER Foods, confections and cosmetics are now being packed in a patented jar which, when emptied, becomes an odor-tight ash receiver The screw cap has an automatic tilting top



AUXILIARY TOWEL RACK. Hooked over any built-in bathroom rack, this simple device gives two extra full-length bars for hanging towels. It is made of solid brass, plated with chromium

ROTARY FOOD PRESS. The handy kitchen appliance at the right presses fruits, rices potatoes, strains vegetables, and removes skins and seeds, and is self-cleaning



HIGHBALL RACK Individual swinging rings in the tilt-top rack at the right hold glasses, ice bucket, and bottle bucket so that they won't spill

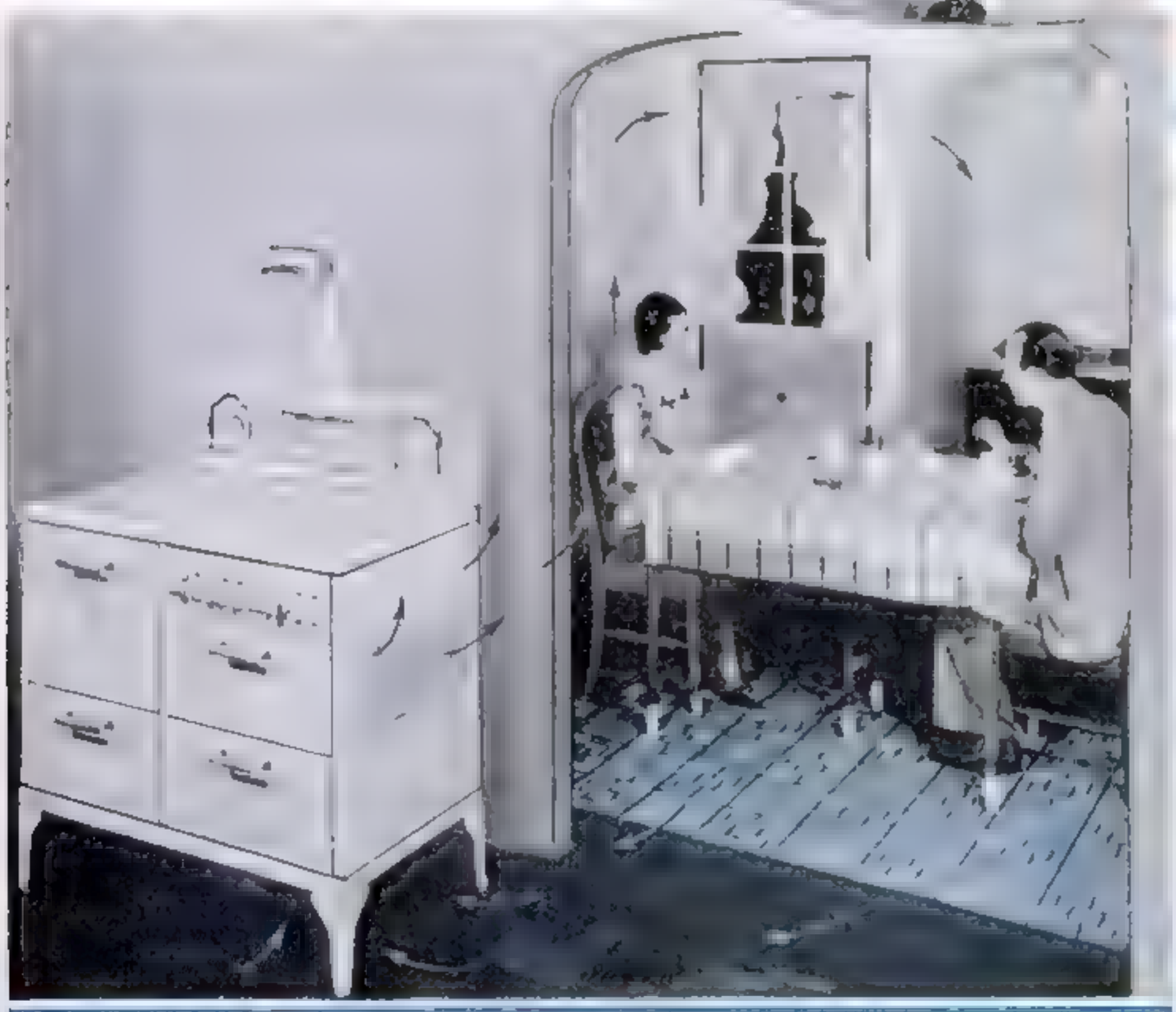
CORN DECOBBER When an ear of green corn is placed in the machine at the left, and the crank is turned, a cutter travels along the ear and strips the kernels from it

ROCKING PITCHER FRAME. Pouring drinks from a large, heavy pitcher is made easy by this chromium frame. The pitcher rests on a bracket at the bottom, and is tipped by pushing the frame over on the gracefully curved runners

"PALETTE" SALAD BOWL. Fashioned like an artist's palette, the novel serving device at the right has separate compartments for olives, pickles, and other appetizers. Implements resemble brushes

WASH-BASIN STRAINER The spiral brush on the attachment below remains in the drain-pipe of the basin, where it catches loose hair, dirt, caps of tooth-paste tubes, and other objects that would clog the drain It is easily pulled out of the pipe for occasional cleaning

COFFEE MAKER Visual measurement indications on this transparent electric coffee maker do away with the annoyance of measuring the water separately. The lower bowl has a wide mouth for easy cleaning, and is provided with a pouring lip. A cover is supplied for each of the two bowls



GAS RANGE HAS BUILT-IN HEATER. Cozy warmth for cool mornings is provided by a circulating air heater built into a new gas range. At the turn of a valve, a current of warm air comes out of a grille in the side of the stove, to circulate through the kitchen and breakfast room

SPOT REMOVER A new chemical preparation for removing spots from clothing, upholstery, draperies, and other articles is put up in a patented container with which the liquid can be applied directly to the fabric. Removing the cap exposes a self-feeding mohair brush that passes just the right amount of fluid to clean properly

CONCEALED SCALES. When not in use, these bathroom scales fold back into a recess in the wall. A convenient handle forms a support for the hinged platform, which is flush with the wall when closed

Our earth might be an innocent bystander in a flaming duel between the sun and an invader from outside our own solar system

How Will the World End?

FOR many millions of years, our planet has circled its parent sun on a time schedule so accurate that it varies only a fraction of a second in each century. The earth is always "on time" throughout every round trip.

Yet, it is quite possible that this regular and peaceful schedule may some day be interrupted by an unforeseen event, which, if it *does* occur, will probably bring humanity's greatest and perhaps final, catastrophe! By means of simple experiments, you can study the possible ways in which our planet's doom might come, and show the forces which may some day bring ruthless destruction upon a helpless world.

Strangely, the way which offers the greatest menace to the earth is exactly the way in which the earth itself came into being! It is now generally believed that the material which later condensed into the planets of our solar system was drawn out of the sun in huge tidal streamers, raised by the close passage of another, a wandering sun.

This passage may have been almost a grazing collision, for two great, flaming cigars of incandescent matter, millions of miles long, were lifted by the huge tidal forces out of our sun

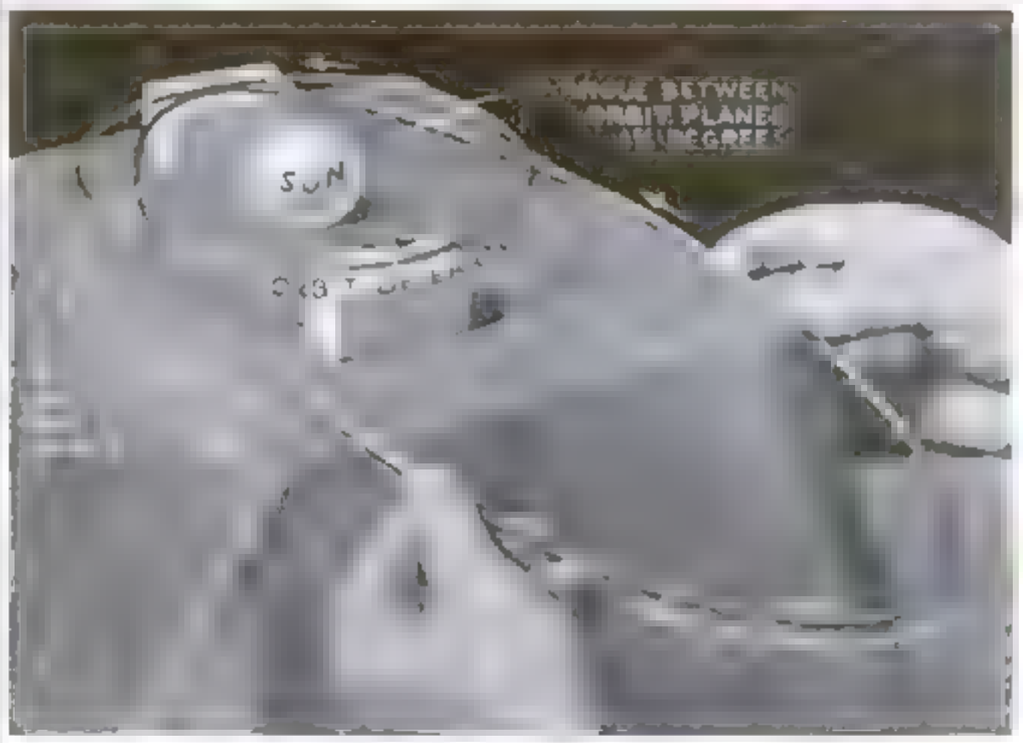
Later, when the invader receded, and the duel of gravitational forces subsided, the flaming streamers were left circling around the suns which had torn them loose in their titanic tug of war.

Gradually, through condensation and a "sweeping up" of little masses by bigger ones, the planets of our solar system were formed out of the floating streamers of our sun. Of the offspring, one, at least, produced conditions which brought about life as we know it.

What happened to the other sun and its circling planet material we do not know. It may still be visible through powerful telescopes, as one of those faint stars which the "red shift" of the spectroscope tells us are receding steadily from our solar system. (P. S. M., June '34, p. 103.) We have no means of knowing where to look for this wanderer, for we do not know in which direction it left us.

And that is exactly the uncertain state of affairs with regard to a possible invasion of our peace by another wandering sun. We do not know which way to look for its possible approach. Any one of those distant suns which our spectroscopes say are coming our way may keep on coming —*straight for us!* We have no way of knowing.

Some astronomers tell us that close approaches and grazing passages of suns are

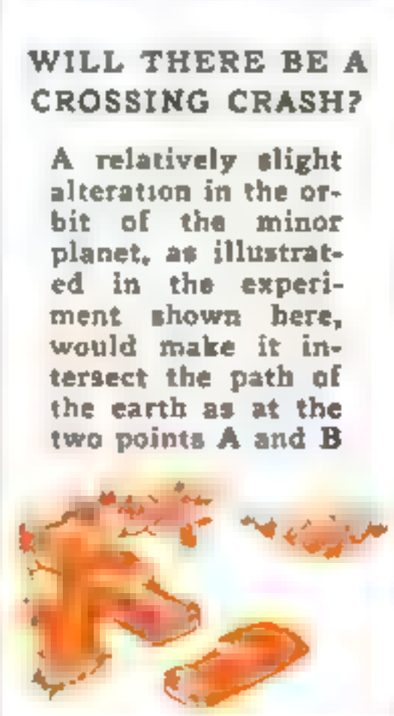


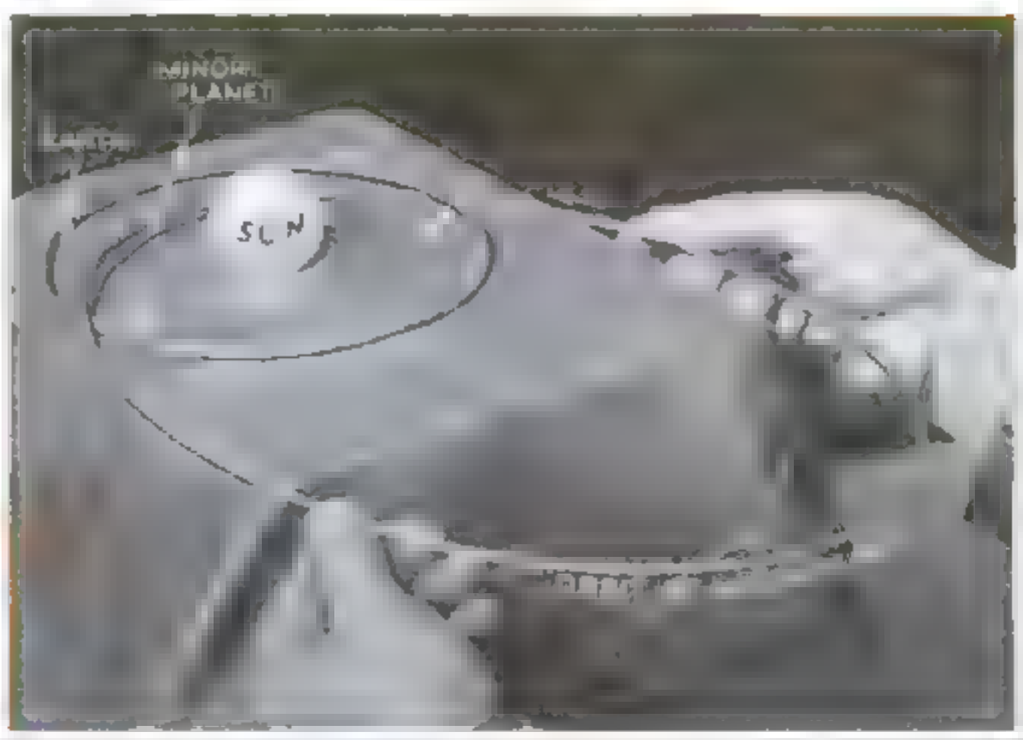
PLANETS MEET AT AN "OVERPASS"

Like an auto shooting across a parkway on a bridge, a baby planet whizzed past the orbit of the earth only a few months ago. It missed our world by a scant 1,500,000 miles

WILL THERE BE A CROSSING CRASH?

A relatively slight alteration in the orbit of the minor planet, as illustrated in the experiment shown here, would make it intersect the path of the earth as at the two points A and B





very rare indeed. Others think them more frequent. But this much is certain: what has happened may happen again—and if another wandering star should travel in our direction, we would be in for such trouble as the earth has never known in all its countless hundreds of years.

Our first warning might come when some observer of variable stars noticed that a particular dot of light showed a steadily increasing brightness. Then, as the brilliancy of the oncoming sun continued to grow, its path would become the principal subject of study for all the astronomers on earth. They would have plenty of time to plot its course, for even at the enormous speeds with which stars travel, it would require many years, perhaps centuries, for the approaching destroyer to come close enough to influence the movements of our solar system.

The first "perturbations" caused by the tidal pull of the invader would of course affect our outermost planets, Pluto and Neptune, provided that they happened to be in the parts of their orbits that lay in the oncoming sun's road. If so, these planets would soon move more slowly; they would no longer fulfill the time schedule which astronomers have laboriously determined from their movements.

And then, as the visitor's influence over our system grew, steadily and relentlessly, we should observe that our greatest planets, Saturn and Jupiter, were no longer "running on time."

By this time, daily and hourly bulletins from the world's observatories would be front-page news all over the world. As the doom of our sun's family, and, therefore, that of the earth, became more and more inevitable, we should see startling changes in human affairs.

And then astronomers would find that our neighbor Mars and the earth itself were obeying the attraction of the invading star as much as that of their own sun.

IF A PLANETOID SHOULD COLLIDE WITH THE EARTH

Here our artist imagines the scene that would be enacted if a minor planet like our recent visitor, Anteros, should strike the earth at the National Capitol in Washington, D. C. A mass of metal, a mile or two in diameter, hurtling through the air at a terrific speed and white-hot from friction with the air, would spread destruction over a huge portion of our globe

By GAYLORD JOHNSON

•

The inclination of our polar axis might change, making navigation by the sun and stars uncertain, perilous, or entirely impossible. Nothing, in fact, would remain normal except the rotation of the earth on its axis.

The whole world's climate would become fiercely torrid, due to the hot rays of two suns instead of one. In a blaze of continuous, merciless sunlight, even night and day might cease to exist. And, finally, the great tidal streamers of flame from the two fiercely contending suns would vaporize all the planets, including our own, as drops of water disappear on a hot stove.

But this would occur to a world already bereft of life, for, long before the final cataclysm, we should have lost consciousness in the scorching atmosphere, and fields, streams, and seas would have dried up and vanished, in smoke and steam!

The size of the flaming prominences which would be raised out of both suns by their near approach can be imagined from a glance at the actual photograph of a solar prominence, which was raised merely by the sun's internal forces. It looks filmy and small in the photograph, but it is over a quarter of a million miles high—more than twice the distance from our earth to the moon! It is quite conceivable that close approach of the visitor might pull out flaming projections far enough to vaporize our earth, for it must be remembered that all our planets were formed from such a streamer of matter, and that Pluto, the farthermost one, is now 4,650,000,000 miles from our present sun. The original streamer must have been a long one!

So much for this possibility of world catastrophe. We must now leave it, and investigate briefly the other way in which the end of our earth might come to pass.

In this case, the destroyer would not be an intruder from outside, but a member of the sun's own family—one of the several hundred minor planets, or "planetoids," most of which revolve around the sun in orbits between the paths of Mars and Jupiter. That they do not all do so has been known to astronomers for a long time, and has been startlingly proved within the past few months.

In fact, only a few months ago a minor planet actually *(Continued on page 123)*

EASY EXPERIMENTS GIVE YOU A PREVIEW OF THE DESTRUCTION OF OUR EARTH BY FLAMING SUNS OR RUNAWAY BABY PLANETS

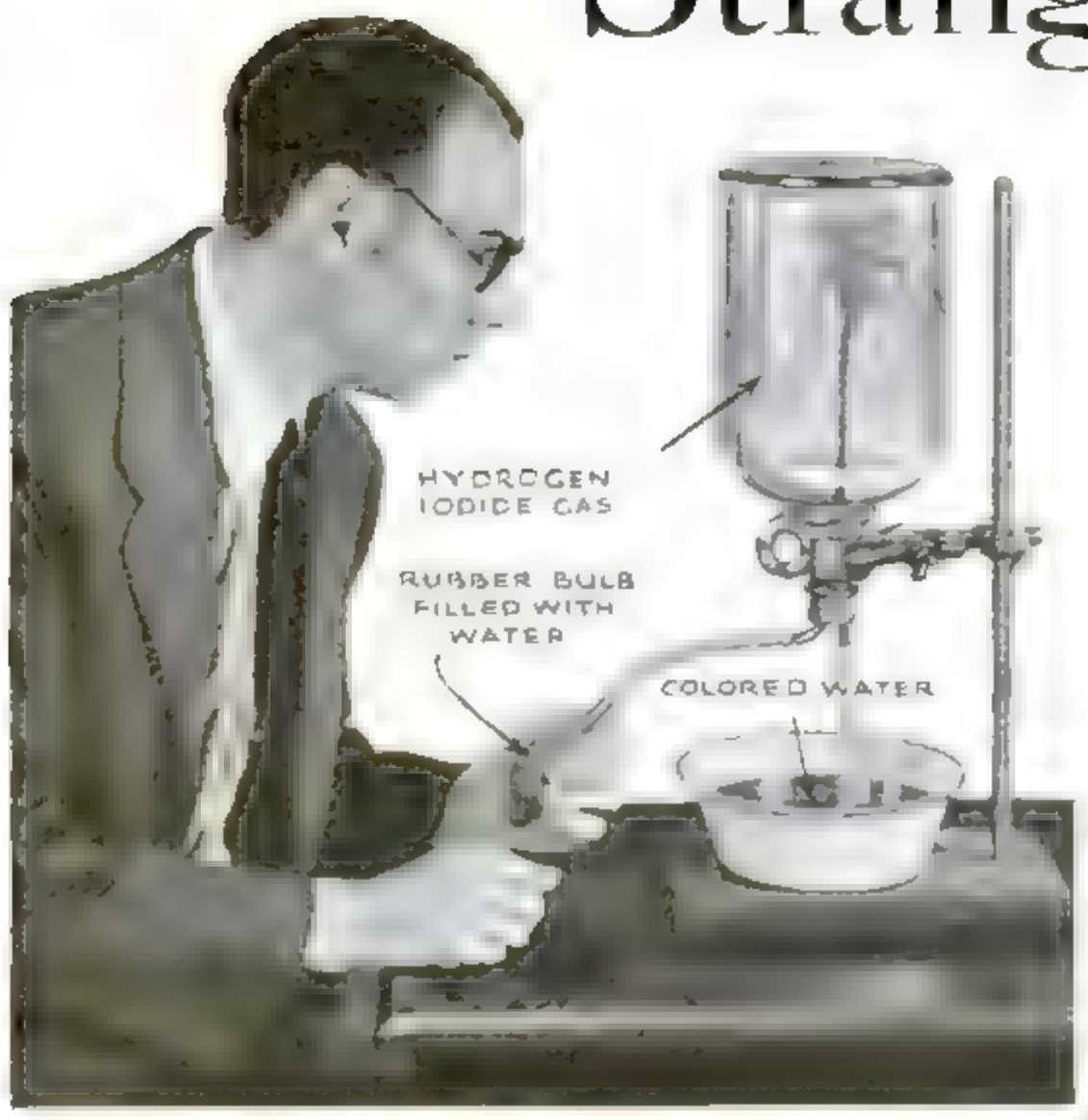
EARTH VERSUS PLANET

This test with a magnet and a steel ball shows how the earth's attraction might deflect a planetoid from its orbit. At right, pictograph of the sun shows fiery rockets that may destroy the earth

Strange Behavior of

Ammonia, Too, Offers Fascinating Tests And Spectacular Displays To Illustrate Little-Known Facts of Chemical Science

By RAYMOND B. WAILES

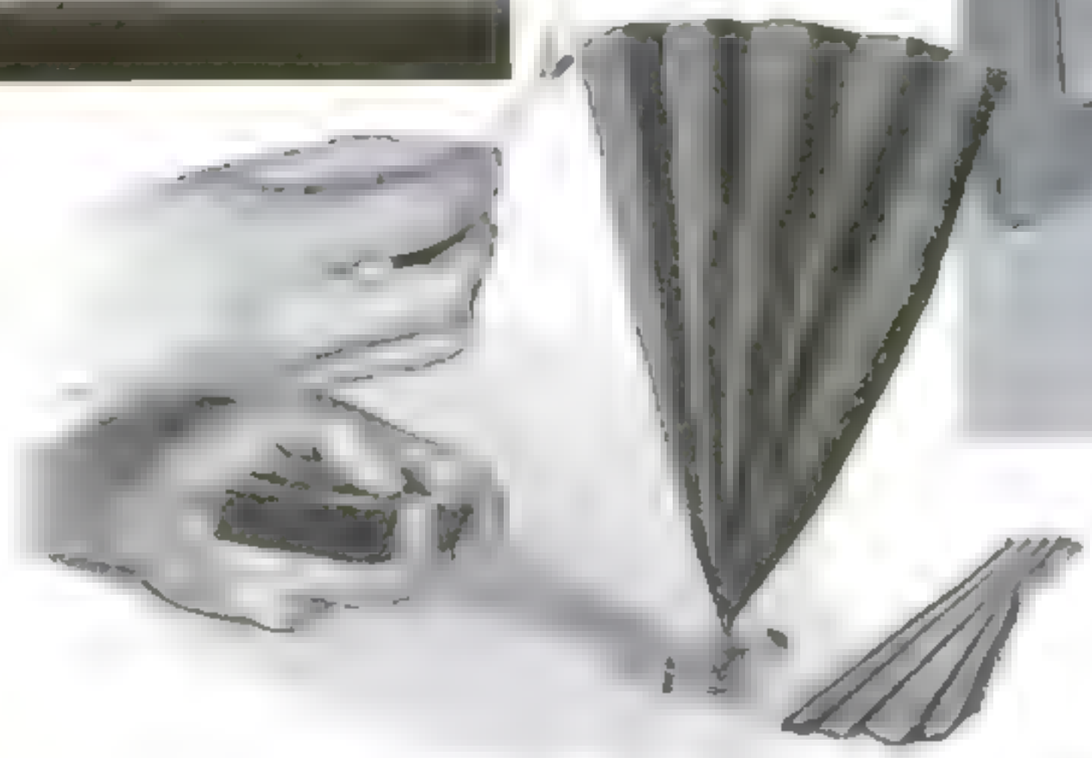


A CHEMICAL FOUNTAIN

Water squirted into a bottle filled with hydrogen iodide dissolves some of the gas and creates a vacuum, drawing colored water up from the pan below in a steady stream, without mechanical aids

BURNED PAPER YIELDS PAINT

Peculiar formations of chromic oxide are produced when paper impregnated with ammonium dichromate is folded and burned as below. The ashes are chromic oxide, a pigment used in green paint



Paper sensitized to light with ammonium dichromate reacts differently to rays of different wave lengths, as this test with a prism proves. Blue and violet rays discolor it, while red rays do not

DO YOU KNOW what iodine looks like? The brown, stinging, antiseptic fluid that you buy at the drug store to apply to a cut or a scratch—which most people know as iodine—is actually a "tincture" or solution of the element in alcohol. Pure iodine is a solid substance. Its black crystals, which turn to a violet vapor when they are heated, offer a variety of interesting experiments for the amateur chemist.

You can obtain iodine in its pure, solid form by heating tincture of iodine gently in a large test tube until the alcohol is driven off. Any escaping iodine vapor can be trapped by a glass funnel suspended upside down above the test tube. The iodine condenses upon the funnel, and the crystals may be scraped off and bottled for future use. A mixture of potassium iodide, manganese dioxide, and strong sulphuric acid also yields copious quantities of iodine vapor when it is heated, and the iodine crystals may be recovered with a funnel as before. As in all experiments with iodine, avoid breathing the heavy, violet vapor.

Try mixing iodine crystals with zinc dust and adding a drop of water. The iodine combines with the metal with a flash of light and a puff of smoke. Either powdered aluminum or aluminum bronze may be substituted for the zinc, with the same result. Iodides of the metals are formed by the reaction.

Rub iodine crystals and a drop of mercury together in a mortar, with a pestle, and the two will combine. Heating the ingredients adds mild fireworks to the reaction. Aluminum or zinc will also combine with iodine, when heated in a test tube, without the addition of water. Keep the mouth of the test tube pointing away from you, so that no tiny rockets will come your way.

Crush some iodine crystals and let them stand for an hour in household ammonia, or in strong ammonium hydroxide. The black residue that forms is an unstable compound known as nitrogen iodide. Filter it off and let it dry, after dividing the muddy deposit on the filter paper into small segregated portions. If the dried compound is touched or rubbed, a harmless miniature explosion occurs and a cloud of violet-colored iodine vapor is released. Sometimes the material detonates spontaneously as it dries.

Hydrogen iodide, a compound of iodine with hydrogen, is an interesting new gas to make in your home laboratory. One way to obtain it is to pass hydrogen through a heated glass tube containing iodine crystals.

A better way to generate hydrogen iodide, which gives a steadier flow of the gas and does not require large quantities of hydrogen, employs the apparatus shown in the illustrations. For the chemical mixture, use one part of iodine, two parts of ordinary rosin, and one part of common, dried sand. These ingredients are placed in a small chemical flask fitted with a one-hole stopper, and heated; the purpose of the sand is to distribute the heat evenly.

Lead the gas that is formed through a glass tube that extends nearly to the bottom of a large test tube, at least an inch in diameter, or an ordinary olive bottle. This vessel should be fitted with a two-hole stopper, and supported high enough above the laboratory table so that a can of ice water can be placed around it to keep it cool. A second piece of glass tubing in the remaining hole of the stopper connects the vessel with a glass U tube containing glass beads and red phosphorus. A bent piece of tubing attached to the latter delivers the gas to the collecting bottles.

When you apply heat to the gas-generating flask, the reaction that results is quite complex. The rosin decomposes and interacts with the iodine to form hydrogen iodide. The decomposition also produces unwanted vapors of liquid hydrocarbons, which are condensed and trapped in the ice-cooled vessel. Crystals of iodine, forming on the cool inner walls of the vessel, show that surplus iodine vapors also are trapped here. Any iodine vapors that

IODINE SHOWN IN EASY HOME EXPERIMENTS

get past—as they may do if the water surrounding the trap is allowed to warm up—will be removed by the red phosphorus in the U tube. If you take care to see that the cooling vessel is kept well chilled, the phosphorus need not be used; the glass beads alone will act as an air condenser for impurities that the ice-cooled vessel fails to remove.

Most of the water vapor in the hydrogen iodide gas is removed by the apparatus just described. The gas can be obtained entirely free of water vapor by attaching a glass tube filled with anhydrous calcium chloride to the end of the train of gas-generating and purifying equipment.

Since hydrogen iodide is heavier than air, point the bent end of the delivery tube downward and insert the collecting bottles from below. The pungent gas displaces the air in the bottles and fills them like water from a spout. Sheets of cardboard can be laid across the tops of the bottles to serve as temporary stoppers.

Insert a glass rod or tube, heated very hot, in a bottle of hydrogen iodide gas and you will see a showy reaction. The hydrogen iodide decomposes with a steady glow of light, giving off vapors of iodine. This experiment shows how easily the gas is broken down into its constituents by heat.

Melt some crystals of potassium chlorate and lower them into a bottle of hydrogen iodide with a deflagrating spoon—a little metal pan or cup riveted on the end of a stiff wire handle. There will be a burst of flame as the oxygen emitted by the chlorate crystals reacts with hydrogen from the gas, which is decomposed by the heat. The experiment is spectacular but harmless, so long as you keep your face away from the mouth of the bottle.

Place a bottle of hydrogen iodide mouth-to-mouth with one of chlorine, and the two gases will mingle and interact with each other, forming hydrogen chloride gas and the violet vapor of iodine. Sulphur dioxide also reacts with hydrogen iodide, often with a flash of light.

Stain a strip of paper orange-red with a solution of potassium dichromate (also called potassium bichromate) and lower it into a bottle of hydrogen iodide. Instantly it is discolored. The gas is said to "reduce" the dichromate compound.

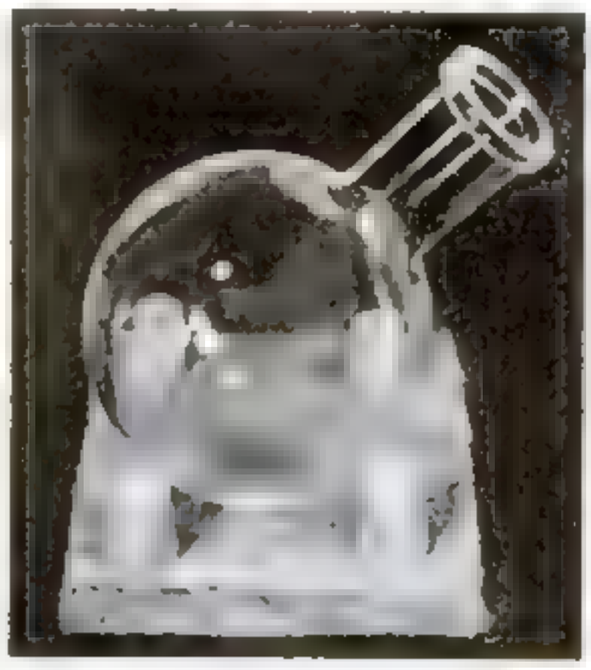
Hydrogen iodide gas dissolves readily in water, producing an acid known as hydriodic acid—just as hydrogen chloride gas, dissolving in water, forms hydrochloric acid.

You can take advantage of the high solubility of hydrogen iodide, which rivals that of ammonia and sulphur dioxide, to create a mysterious "fountain" that works without a pump or any other visible driving force. Fit a large bottle with a two-hole stopper, invert it, and mount it securely upon a laboratory support. Place a pan of water under the bottle, and connect a short length of rubber tubing, leading from this water reservoir, to a glass tube that passes through the bottle cork and ends just within. Through the other hole in the cork, insert an L-shaped glass tube attached to a rubber squirt bulb that is filled with water.

With the assembly dismantled, let hydrogen iodide gas flow from your generating and purifying apparatus into the bottle, using a delivery tube that reaches to its bottom. Then attach the cork and replace the bottle on its support. Squeeze the rubber bulb, forcing an initial stream of water into the bottle. This dissolves some of the gas, leaving a partial vacuum. Atmospheric pressure outside the bottle performs the rest of the experiment for you, forcibly lifting water from the pan and spurting it into the bottle in a steady stream. The experiment will be more striking if you color the water in the pan with litmus indicator solution, made blue by the addition of a drop or two of alkali. As the water enters the bottle, its color will change from blue to red.

With only slight modification, the apparatus that you used for making hydrogen iodide can be employed for preparing an interesting and uncommon compound of ammonia, copper and chlorine. Place about 100 cubic centimeters (four tenths of a drinking glass) of strong ammonium hydroxide solution in the generating flask, and a solution *(Continued on page 127)*

Hydrogen iodide gas is generated by heating a mixture of iodine, rosin, and sand. The photo and drawing show how the equipment is set up. The test tube and U tube trap any impurities

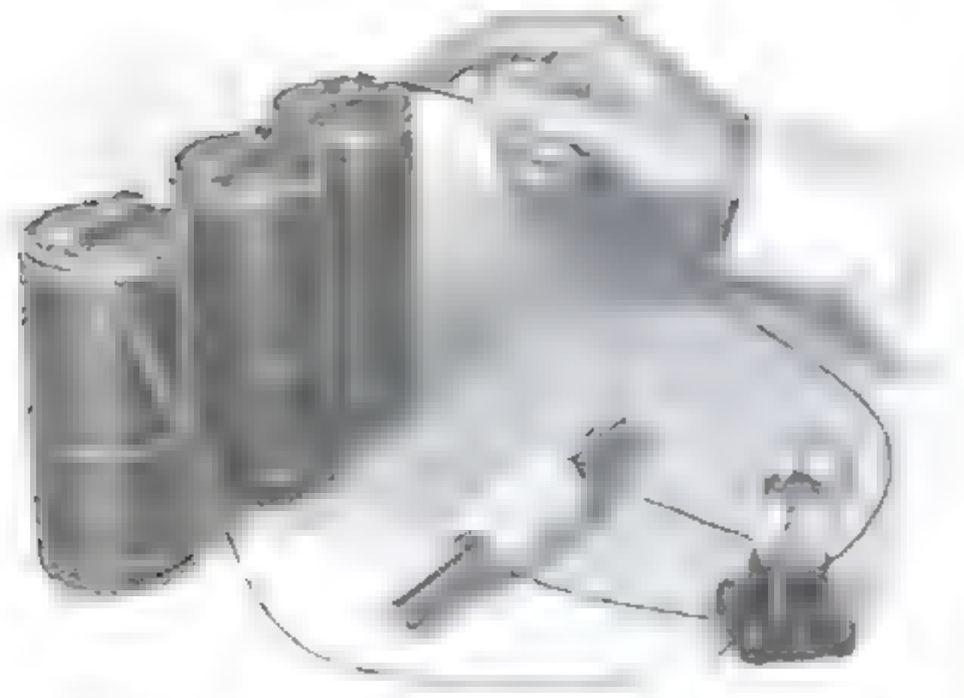


Handy Flask Rest

A HANDY SUPPORT *for a round-bottom flask can be made by nailing corks to a square of insulating board as is shown above. Turned over, it makes a platform for keeping hot objects from marring the table.*

IODINE GAS GIVES VIVID DISPLAY
Molten crystals of potassium chlorate thrust into a jar of hydrogen iodide gas react with a bright burst of flame as oxygen from the chlorate unites with hydrogen from the gas

MAGIC OF SCIENCE IN Simple Home Tests



Three Dry Cells Produce 100 Volts

To PROVE that three dry cells will produce an "inductive kick" of more than 100 volts, connect a small neon bulb as shown above with a coil consisting of 700 turns of wire around an iron-wire core. Each time the circuit is broken, the bulb will flash momentarily as the collapse of the magnetic field boosts the voltage. Since the bulb will not light with less than 100 volts, it gauges the induced current.

Grease Spot Used To Test Lights

You can measure the relative brightness of two light sources by holding between them a white filing card on which a grease spot has been made with ordinary lard. When the card receives more light from one source than from the other, the spot will glow. When both light it equally, it disappears; and the card's position shows the relative brightness.

"Hydraulic Ram" Lifts Water Above Source

WATER can be made to rise above the level of its source by applying the principle of the hydraulic ram. Allow the liquid to flow freely from a rubber hose, and then suddenly close the end partially by pinching it. The water will spurt up, for a moment, above the level from which it is flowing, as shown in the photograph. The reason is that the weight of a large amount of water in the tube is suddenly brought to bear on a small amount at the end, raising it forcibly.

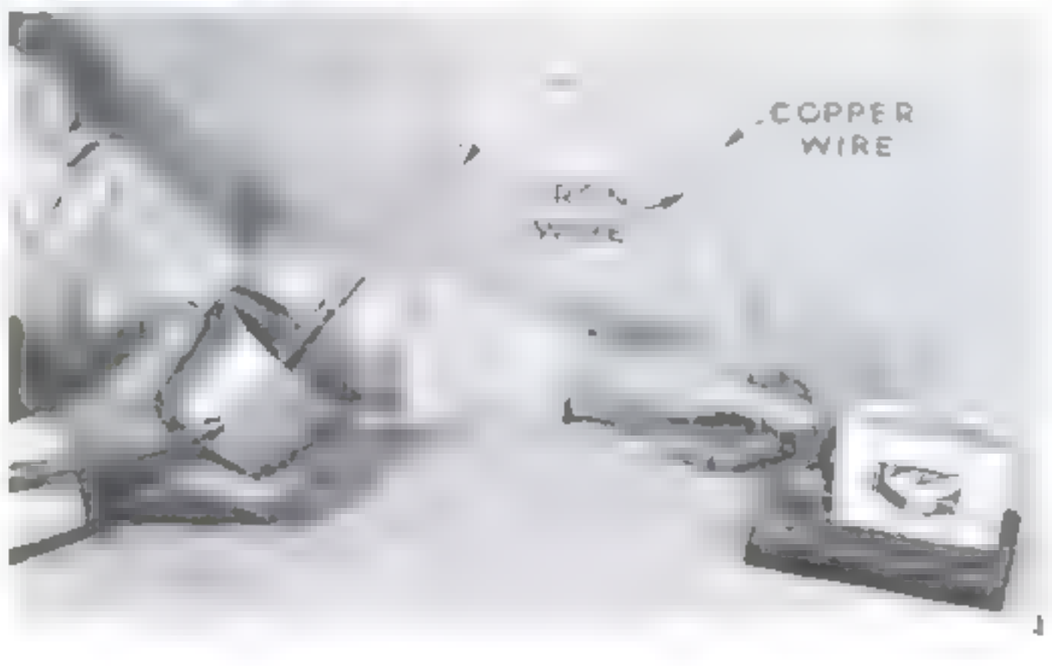
Current Makes Coil Contract

WIND a coil of copper wire and mount it as shown at the left, with the lower end of the wire dipping into a dish of mercury. When the circuit from the dry cell is completed, the coil will vibrate up and down. Magnetic currents set up around each turn of the wire attract the adjacent turns, causing the coil to contract. When it contracts, the wire is raised, breaking the circuit. This principle is utilized in electric motors.

Copper Is Hardened By Hammering

IT IS generally believed that the hardening of copper is a lost art, but this is a fallacy. To prove it, take a piece of heavy copper wire that has been made soft by heating and cooling, and hammer it near the center. Bend the wire, and the hammered portion will remain straight, proving that it is harder than the rest. The hammering causes the change by altering the crystalline structure of the metal as does drawing it through a die.

Heat Generates Electricity in Coupled Metals



TWIST together the ends of a copper and iron wire, and connect the other ends to a simple galvanometer made by placing a magnetic compass inside a coil of 500 turns of wire. (If you have a sensitive milliammeter, that may be used instead of the galvanometer.) Heat the joint of the two wires, and a current will be indicated, the iron wire becoming positive. When the joint is made red-hot, the current will cease; then, as the heat is increased, it will flow the other way. If ice, instead of heat is applied, current is created in the opposite direction.

BUILD YOURSELF A

Wrist-Watch Radio

TINY enough to be worn on your wrist, carried in your pocket, or fastened to your belt, this homemade "two-tube" broadcast receiver sets a new record in compactness. By careful planning, its seventeen standard parts have been crammed into a midget cabinet measuring two and a half inches square and less than one and three quarters inches deep.

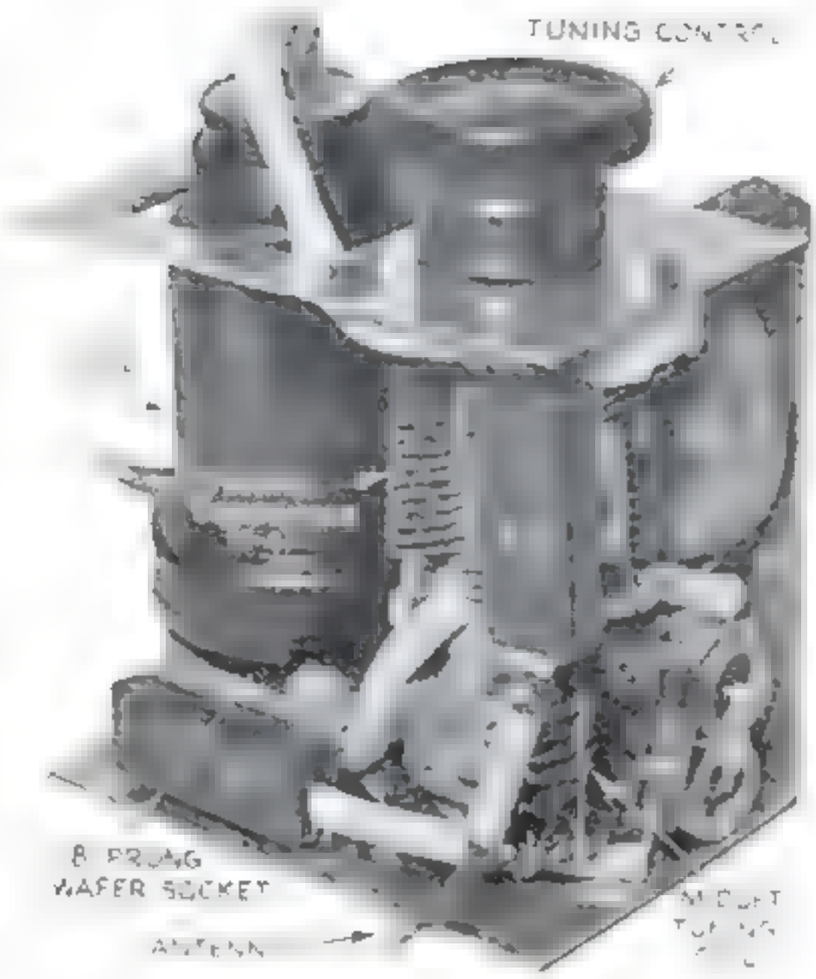
Built around a single dual-purpose metal tube (type 6A8), the circuit consists of a screen-grid detector resistance coupled to a triode audio stage. Being in reality two tubes in one, the 6A8 provides all of the necessary elements in a single casing. As shown in the diagram, one six-volt filament or heater serves the combination tube, saving additional space.

For simplicity, the sheet-aluminum cabinet is made in two parts; a simple U-shaped piece serving as the chassis, and a similar U-shaped unit provided with flanges serving as the cover. To keep the cabinet as small as possible, a square hole should be cut in its upper end to take the projecting head of the 6A8 tube.

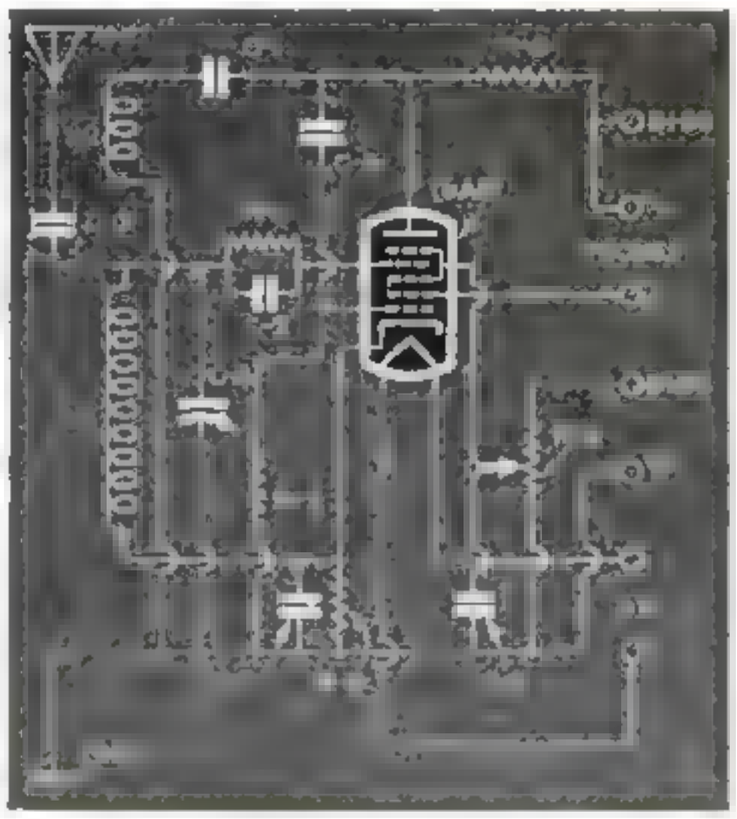
Although standard parts are used throughout, a few minor changes must be made in the interest of compactness. For instance, the standard A.C.-D.C. antenna coil used can be shortened considerably by cutting off the excess cardboard tubing that projects from each end of the coil. Similarly, the wafer-type tube socket can be cut down all around with a pair of sharp scissors. One other minor alteration consists of providing the air-padding condenser (C_4) with a suitable control knob.

In wiring the circuit, follow the placement of the parts shown. First wire the potentiometer, fixed condensers, and resistors, and do not mount the tuning coil, tuning condenser, and tube socket permanently until all the connections have been made. To save space, the coupling condenser (C_6) is mounted inside the hollow core of the tuning coil.

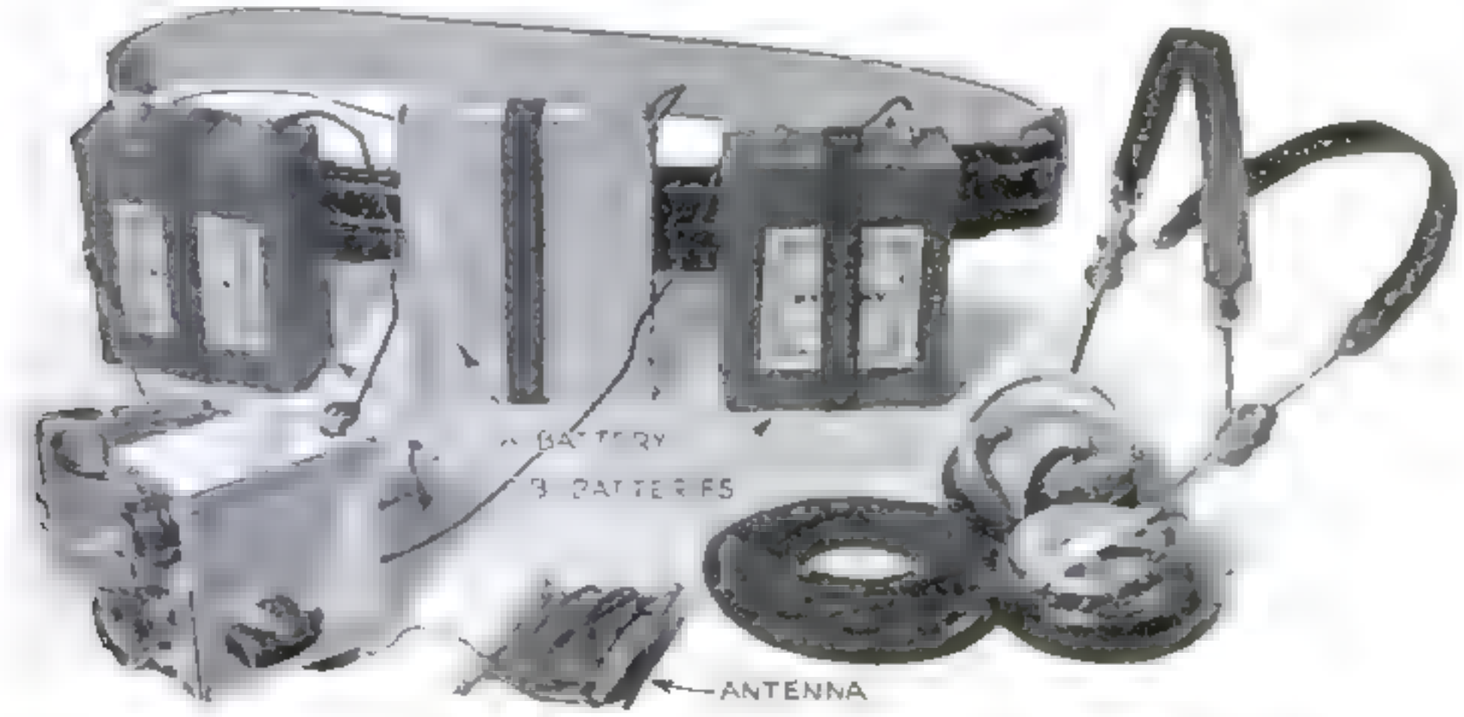
When connected to a ten or fifteen-foot antenna, the set should give good earphone volume. Should the circuit fail to oscillate, switch the connections to the tickler coil (L_2). Some experimenting may be necessary to obtain the right polarity for the winding.—ARTHUR C. MILLER.



Detail view of the receiver with the flanged cover removed to show compact arrangement of parts. Below, wiring diagram of circuit



The midget receiver being used as a wrist radio. Flexible wires, anchored at the armpit, lead to the battery power supply on the belt



An idea of the size of the set can be gained by comparing it with the portable "B" batteries

PARTS NEEDED

C_1.—Mica condenser, midget, .0005 mfd.
C_2.—Mica condenser, midget, .0001 mfd.
C_3.—Mica condenser, midget, .00025 mfd.
C_4.—Air-padding condenser, variable, 100 mmf.
C_5 and C_7.—By-pass condensers, .05 mfd.
C_8.—By-pass condenser, .01 mfd
L_1 and L_3.—Midget A.C.-D.C. antenna coil, broadcast.
R_1.—Resistance, 3 meg., ½ watt.
R_2.—Resistance, 300,000 ohm, ½ watt.
R_3.—Resistance, 250,000 ohm, ½ watt.
R_4.—Resistance, 350 ohm, ½ watt.
R_5.—Potentiometer, 50,000 ohm.
Miscellaneous.—Eight-prong socket, 6A8 tube, two knobs, aluminum case, batteries, wire, earphones, solder, bolts, nuts, etc.

A PAGE OF NEW IDEAS For the Radio Fan

BY MAKING use of flat braided-metal shielding tape or cable, you can provide your car with an efficient concealed roof antenna without disturbing the ceiling lining. As shown in the photographs below, the metal tape first is fastened in the form of an open loop along the edge of the top with ordinary pins. The tape should be placed just inside the rectangle of leatherette that forms the main portion of the top. A continuous one-inch wide strip of adhesive tape then is applied over

1 To install the antenna, the cable first is fastened in place with ordinary pins

2 A strip of adhesive tape then is applied over the cable as the pins are removed

3 Finally, several heavy coats of high-grade auto-top paint complete the job

the shielding as the pins are removed. Finally, several coats of high-grade top paint complete the job. The lead-in, brought up through a small hole, should be soldered to one end of the shielding tape. This type of antenna cannot, of course, be applied to an all-steel car top, but you will find it a simple matter to install it on the other type of top. If it is put on correctly it will not mar the roof at all and the wires will always be in place, thus eliminating repairs.—C.S.S., JR.

Shielded Cable Plug

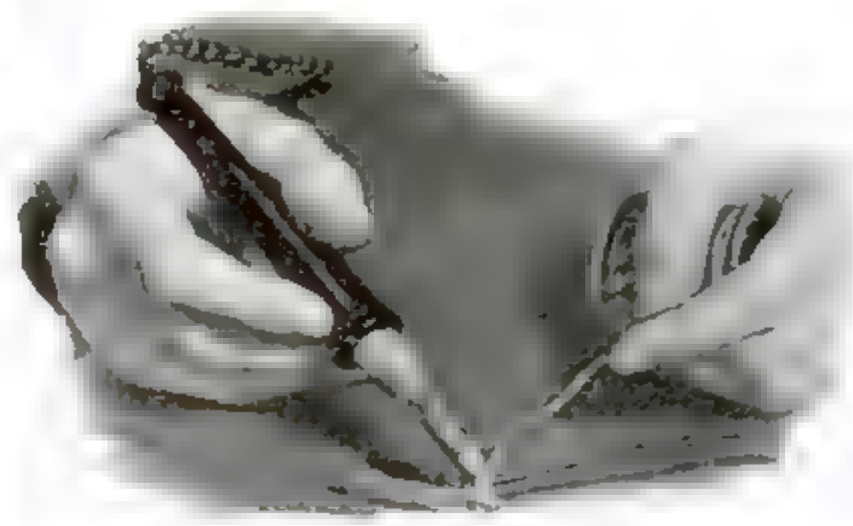
IN PUBLIC-address work, where shielded semipermanent connections are necessary between various units, the aluminum cable-connector plug, cap, and socket shown at the right provide a simple solution to the problem. In use, a built-in threaded collar holds the plug rigidly in the socket. When not in use, a blank cap, conveniently chained to the chassis to prevent loss, shields the socket.

Metal Drawers Can Be Stacked To Form Cabinet

When used as a cabinet, drawers are held together by tabs and slots, as above

ASSORTMENTS of condensers are now sold in attractive metal boxes that form valuable additions to the radio experimenter's shop equipment. Fitted with matching tabs and slots, as indicated in the photograph above, the boxes can be stacked easily to provide a sturdy cabinet of drawers. Label frames on each drawer provide a way of indicating the contents.

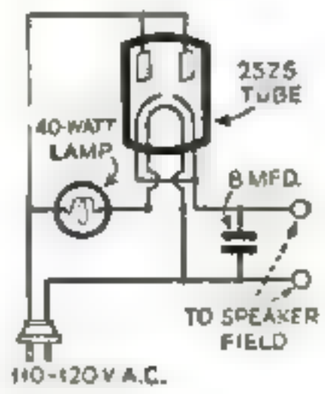
Midget Soldering Iron Operates On Six Volts

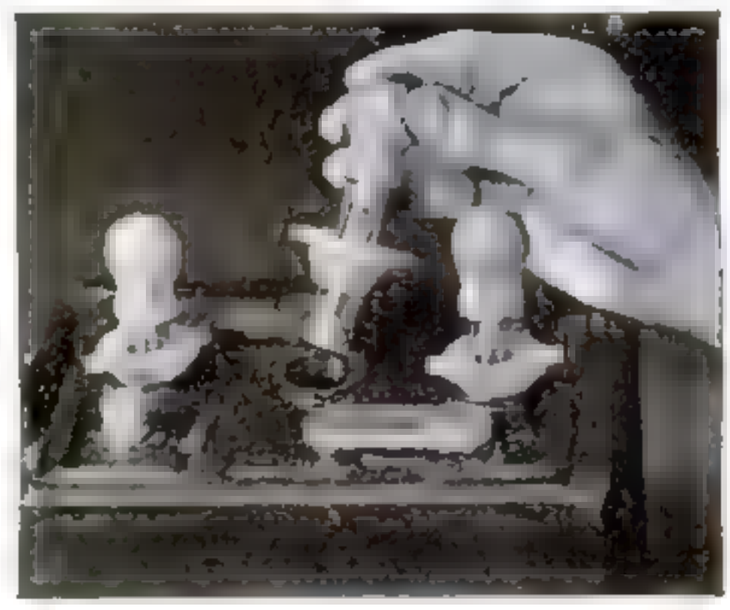


COMPACT and lightweight, the latest in electric soldering irons operates on a storage battery or any other six-volt direct-current source. Resembling a pencil, the new midget tool is particularly suited for delicate work in crowded corners. In spite of its small size and low voltage requirements, however, it heats in less than a minute and can do the work of much larger irons, which are often clumsy to use where extremely fine work is required.

Speaker Field Supply

A SIMPLE field supply for a dynamic speaker can be assembled from a condenser, a forty-watt lamp, and a 25Z5 rectifier tube. Wired as shown, the circuit will supply approximately 100 milliamperes at 130 volts when used with an eight-microfarad condenser. Increasing the condenser size increases the output voltage. The forty-watt bulb serves as a series resistor.



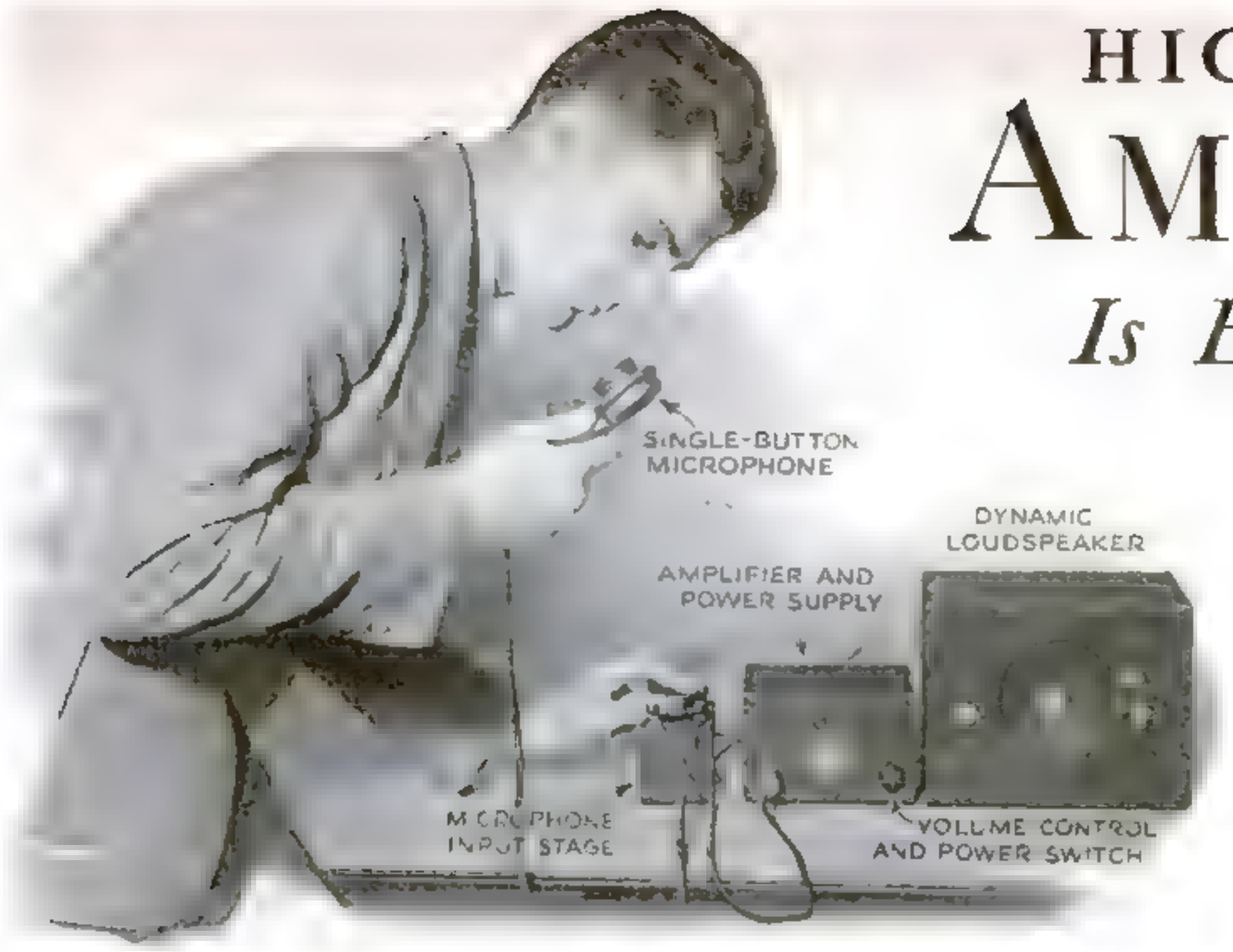


Tiny Battery Testers Serve as Vent Caps

MIDGET hydrometers designed to be screwed into each cell of a storage battery make it an easy matter to check the "charge" condition of each unit. Made of rubber and glass, they are used in place of the regular vent caps and need only be removed when distilled water is added or the battery charged. The tiny testers operate in the same manner as regular large-size hydrometers.

Cable-connector units provide needed shielding

HIGH-POWER AMPLIFIER *Is Easily Made*



The amplifier in use for public-address work. It provides a power output of almost three watts

BECAUSE it can be used as a public-address system, as a phonograph pick-up, or with a small receiver, this "mighty dwarf" amplifier forms an ideal three-in-one unit for the radio experimenter. Although it is small enough to fit into the palm of your hand, weighs only two pounds, and costs little to build, it provides an undistorted power output of almost three watts.

Employing three of the latest-type metal tubes, the circuit consists of two stages of audio amplification, a self-contained power supply, and a rectified 110-volt field supply for a dynamic speaker. The first-stage amplifying tube, a metal type 6J7, is resistance-coupled to the power-output stage, employing a 25A6 metal tube.

Instead of using a power transformer to furnish the high plate voltage, a type 25Z6 metal tube is wired in a voltage-doubler circuit to provide the necessary 180 volts. The filtering system consists of the speaker field shunted by two 8-mfd. tubular electrolytic condensers.

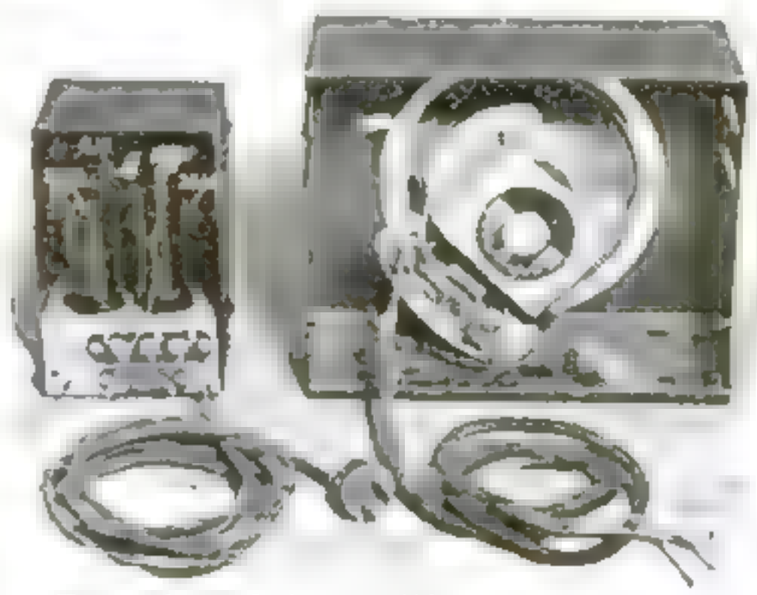
As indicated in the schematic diagram, the filaments of the three tubes are connected in series, a 200-ohm resistor built into the power cord reducing the line voltage to the correct value required by the tubes. Although the general arrangement resembles a universal A.C.-D.C. circuit, this amplifier, due to the voltage-doubler connection of the 25Z6 tube, can be used only on alternating current. To reduce the possibility of shocks, the common negative return is insulated from the metal chassis by a .1-mfd. cartridge-type condenser.

In wiring the amplifier, the chief danger of making a mistake lies at the socket terminals. To eliminate the possibility of any trouble at these points, the tube elements on the schematic diagram are lettered and corresponding lettering is used to designate the terminals in the three socket views.

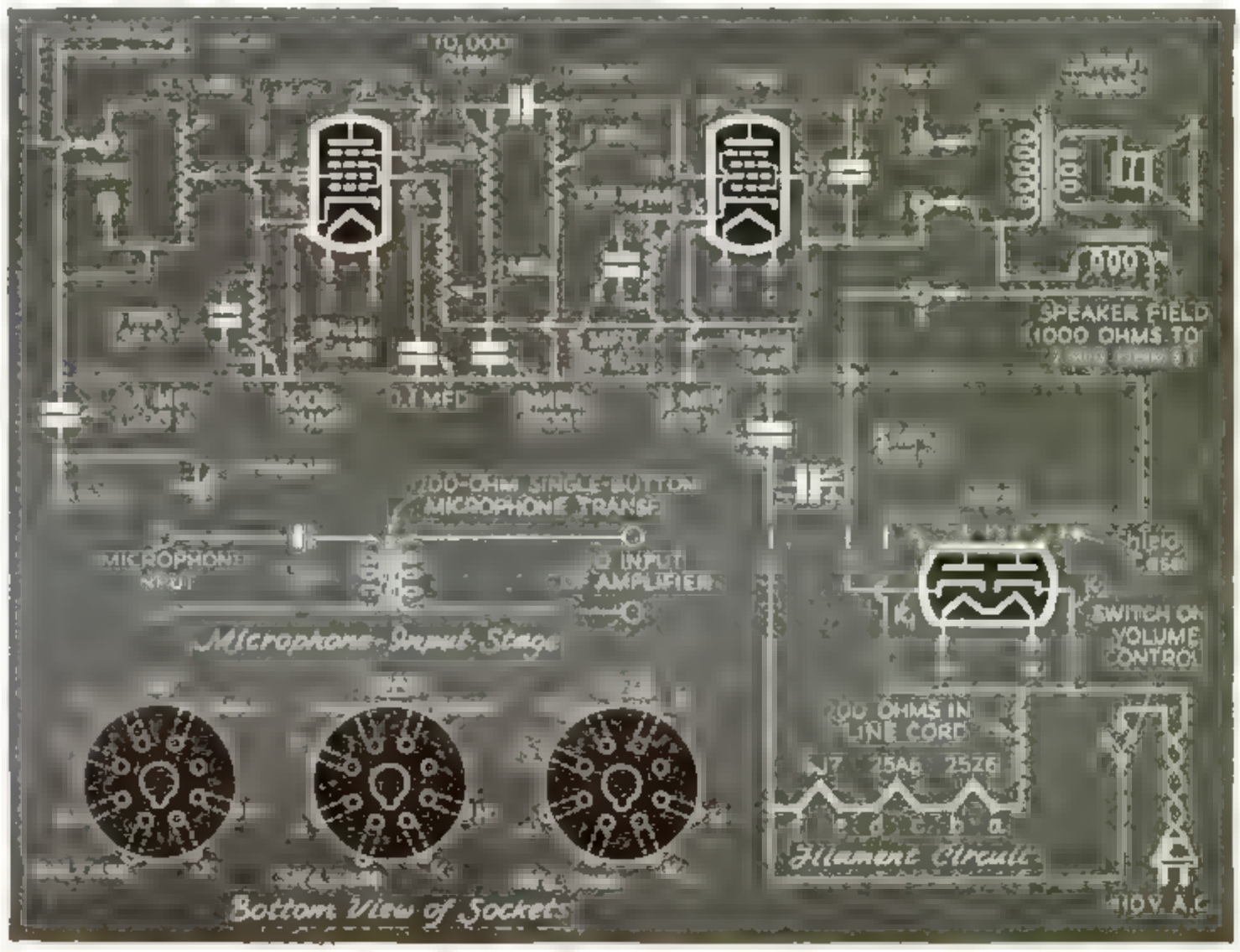
The complete amplifier circuit is mounted on a metal chassis, the three tube sockets being mounted on the chassis deck; the resistors and condensers under the chassis; the input, output, and ground terminals at the rear; and the volume control and input jack on the front wall. The two pin jacks at the rear of the chassis serve as the standard input connections to the amplifier for phonograph pick-up and receiver work, while the three output binding posts are for making connections to the output transformer and field of the dynamic speaker. The plug jack at the front of the chassis simplifies the problem of plugging in a microphone or other additional circuits.

A simple microphone-input stage is a necessary complement to the amplifier if it is to be used as a public-address system. Since the input stage consists simply of a small 200-ohm, single-button microphone transformer, a one and one-half-volt flash-light battery, and provisions for making connections to the microphone and the input of the amplifier, the entire device may be mounted in an extremely small metal box, similar to the one illustrated. Although a variable resistance was used as a part of the original input stage shown, it can be omitted, since adequate control is provided by the 500,000-ohm potentiometer used in the main amplifier circuit.

The dynamic speaker can be mounted in a separate cabinet, made either of metal or wood. If a metal cabinet is used as in the original, a wall-board or wood baffle should be provided. The speaker should be equipped with an output transformer to match a type '43 or a 25A6 tube. These tubes have a load resistance of about 5,000 ohms. The speaker field may have a resistance of from 1,000 to 2,500 ohms. A three-wire cable is sufficient to make the connections from the speaker to the amplifier.—H. G. Cisin.



Rear view of the amplifier and loudspeaker units. Note the small size of the amplifier



Tube elements in the schematic diagram are lettered to correspond with terminals in socket views

Gus Gives Some Hints
On Care and Driving
Of Modern Automobiles
To Get Most Mileage
On a Gallon of Fuel

"Don't you think I ought to get better than twelve miles to the gallon on a car like this, Gus?" Featherston queried

Are You Wasting Gasoline?

By **MARTIN BUNN**

"TWELVE miles to the gallon! And on a long trip, too! Eighteen miles to the gallon is what I'm supposed to get with this new car, but do I get it? I do *not!*" Martin Featherston muttered angrily to himself as he checked, for the fourth time, his mileage figures against the gas he had used on his recent trip.

"Well," he growled, snapping his notebook shut, "either those advertisements are a lot of bunk, or else there's something wrong with this car. I'd better do something about it."

A few minutes later, he pulled into the Model Garage, climbed out of his new sedan, and spotted a huge pair of feet sticking out from underneath another car. "Hey, Gus!" he called. "Have you got time to look at my car?"

"Just a minute and I'll be with you," came in a muffled voice from Gus Wilson, veteran auto mechanic and half owner of the establishment, as a huge and grimy hand appeared, gripped a spanner, and disappeared under the car again.

"Don't you think I ought to get better than twelve miles to the gallon on a car like this when I'm off on long trips?" Featherston asked, as Gus started wriggling out. "Of course, if that eighteen-to-twenty-miles-a-gallon claim of the manufacturers is a lot of hooey, then I suppose there's nothing to be done about it. I've had it at the agency several times, but it always comes back no better than it was when I brought it in."

Gus chuckled as he wiped his hands on a wad of waste. "That claim may be a bit optimistic, but twelve miles to the gallon certainly is low. You ought to get at least sixteen or seventeen under average conditions. Let me try it on the road."

Gus climbed behind the wheel and Featherston got in beside him. The car ran with perfect smoothness and, so far as Featherston could see, gave no indication of poor carburetor adjustment. The motor did not surge or romp as it would have done if the gas mixture had been much too rich.

When they got back to the garage, Gus lifted the hood. "I suppose the agency men have checked the carburetor, but it won't do any harm to look at it again," he observed. He carefully tested the idling adjustment, then removed the top of the float chamber and noted that the level of the gasoline was at just the right height.

"And I'll bet they checked the ignition, too," he muttered, half to himself, as he stood gazing at the distributor. "So, chances are the trouble isn't there, although the motor doesn't seem to have as much pep as it should. Perhaps the automatic spark control may not be right. They don't always check that. I'd better have a look—well, I'll be jiggered!" He turned to Featherston in surprise.

"Look at this," he called. "See that kink in the vacuum line to the distributor head? Somehow that pipe got a twist that closed it up so that the vacuum can't advance the spark as it should. The result is that the motor is running with the spark retarded more than it should be. No wonder you're getting no economy in your gas consumption!"

The twist in the vacuum line was in such a location that a casual inspection would not have revealed it, so that it got by the agency service men.

"Seems to me these new cars have too many new-fangled gadgets," Featherston observed. "That couldn't have happened on an old car with plain manual spark control, could it?"

"No, it couldn't," Gus admitted, as he measured for a new pipe, "but, on the other hand, unless you're a real expert, you couldn't hand-control the spark as accurately as this system does when it's working right."

"And it can't forget," smiled Featherston reminiscently. "I can remember when I had the motor boiling hot, and nearly burned out a set of exhaust valves on an old car because I forgot to advance the spark. But, in those days, we at least knew enough to blame ourselves for doing something wrong."

"You still can blame yourself for doing one thing, at least, that doesn't help any if you're after gas mileage records," said Gus, "and that's hopping on the throttle a couple of times just before you let in the clutch for a start."

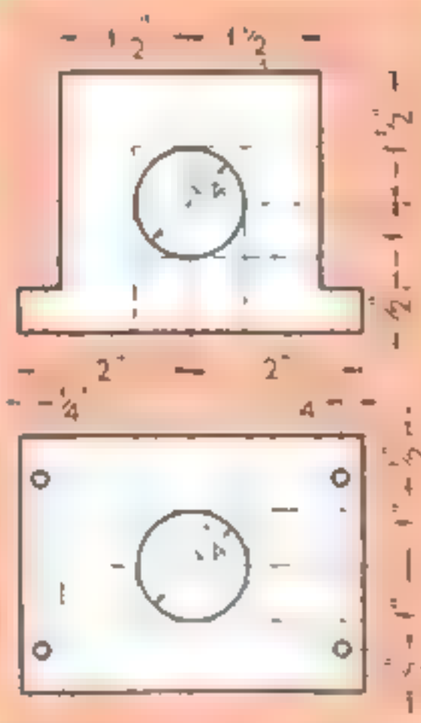
"What's the matter with doing that?" Featherston *(Continued on page 129)*

EASILY INSTALLED

Vacuum System

FREES SHOP OF DUST

By Frank E. Johnson



Combination belt and disk sander in Johnson's dustless home workshop. The vacuum hose leads from each section of the machine to a three-way block, made as shown at left

HOW often have you wished for a continually clean power bench and tools instead of a pile of sawdust or shavings around each machine? You may have this and more by installing an efficient and easily built vacuum system of the type illustrated. This does a remarkable job of removing all sawdust at its source. It is also beneficial from a health standpoint, as the air is free from the clouds of dust that otherwise are always arising from the various power tools.

First, obtain a straight suction type vacuum-cleaner unit, either by purchasing a second-hand or rebuilt one, or borrowing the one in your home. The average housewife uses her vacuum cleaner about once a week. To use it between times in the workshop takes only about a minute to remove the handle and mount it in place by slipping four loops of cord over the wheels. The standard bag may be used, although the writer made a larger bag to hold more sawdust.

The pipe lines leading to the power tools may be standard vacuum-cleaner hose or standard steam hose. The former is obtained from your electrical dealer at about $2.25 for an 8-ft. length. The steam hose is sold at hardware stores for about 25 cents a foot. The sizes in this article are for hose of 1¼-in. inside diameter. For hose of different diameters, allow accordingly.

To obtain maximum suction at the vantage point of each machine, it will be necessary to construct a control valve. The parts of this are shown at the left, and the assembled valve on the following page. The smaller spring, which is of ½-in. diameter, and the larger spring, the size of which is not important, may be obtained for a few cents at a junk yard or a hardware store.

Lay out the two valve blocks on a close-grained wood and saw them out. Plane and sand the valve faces so that they

A NATIONAL HOMEWORKSHOP GUILD FEATURE

Parts of control valve for the entire system. The assembled valve is shown on the next page

Standard vacuum-cleaner nozzles are used to trap the dust from both the belt and the disk of the small combination sander

The assembled control valve is fastened by means of a wooden bracket beneath the bench. The lower valve block turns to connect the vacuum cleaner with any machine

The valve handle is above the bench top. Dowels are set in the bench as markers to indicate the position for applying suction to each machine

At right is another view of the control valve with the hose from the different machines in place. The two small tubes come from above and lead to the jig saw

Top and edge views of the upper and lower valve blocks. These parts are made of close-grained wood, and the faces must be smooth and true in order to prevent leakage of air. The assembly is shown in the photos above

are smooth and true. It is imperative that these faces be true and remain so, as air leaks at this point will impair the efficiency of the system.

With an expansion bit, drill the 1¼-in. hole in the lower valve block. When boring the portholes, set the bit a trifle undersize to assure a press fit when the sleeves are assembled. Next, clamp the valve blocks together in their correct relation to each other and drill the ½-in. hole through the center of both. Insert a short piece of ½-in. diameter shaft through this hole and remove the clamps. The two pieces will now rotate about their common axis. You may now assure a perfect registration of the valve ports by using the porthole in the lower valve block as a jig for drilling the portholes in the upper valve block.

For the valve blocks to remain true, they must be treated to prevent warping. You may readily do this by sizing them with an application of thin, hot glue well rubbed in, or if you prefer, boiling them in paraffin for about ten minutes. Resand the faces with fine sandpaper and lay aside while proceeding with the next step.

From a piece of scrap wood construct the valve register and screw it to the lower valve block as shown in the drawing. Assemble the two valve blocks with the ½-in. diameter pin, and insert a ½-in. drill through the hole in the valve register. Upon the perfect registration of each valve port, make a small seat in the upper valve block with the drill point. This is the seat that the spring-loaded ball bearing will drop into to denote registration. Remove the drill and drop the ½-in. ball and spring into the hole. Insert a ½-in. dowel stick and compress the spring until sufficient pressure is exerted to hold the outer edges of the blocks firmly together. Mark the dowel, glue in place, and cut off flush with the top. Make the sleeves of 1¼-in. inside diameter by 1¼-in. outside diameter tubing, 3 in. long, and press into the portholes.

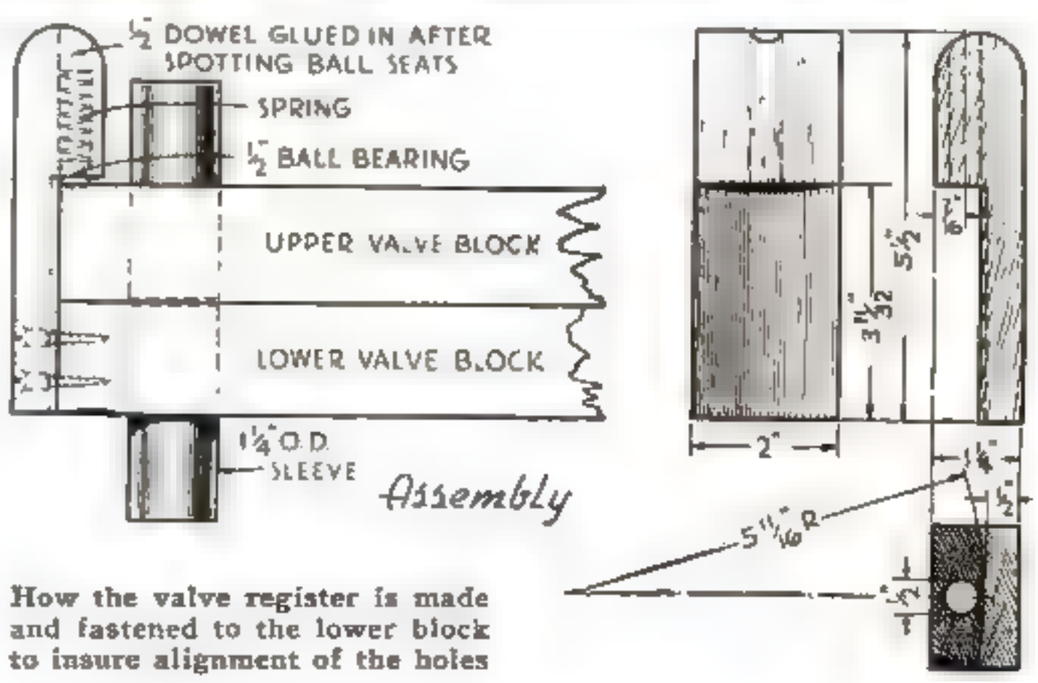
The next thing to consider is the location of the valve on the bench. Select a place that is most convenient to all machines. Construct the valve bracket so there is at least 7 in. clearance between the upper valve block and the underside of the bench. Screw the lower part of the bracket to the upper valve block and attach them in place under the bench. Cut the ½-in. diameter steel shaft and insert through the valve block until it hits the underside of the bench. Tap the shaft lightly with a mallet until an indication is made for drilling the hole in the bench.

Now visit the scrap pile for a piece of metal, preferably flange shaped although not necessarily so. This is for fastening the shaft to the lower valve block so they will rotate together. Drill the shaft and screw holes and fasten it securely to the lower valve block. Drill the shaft and flange together, and fasten with a cotter pin.

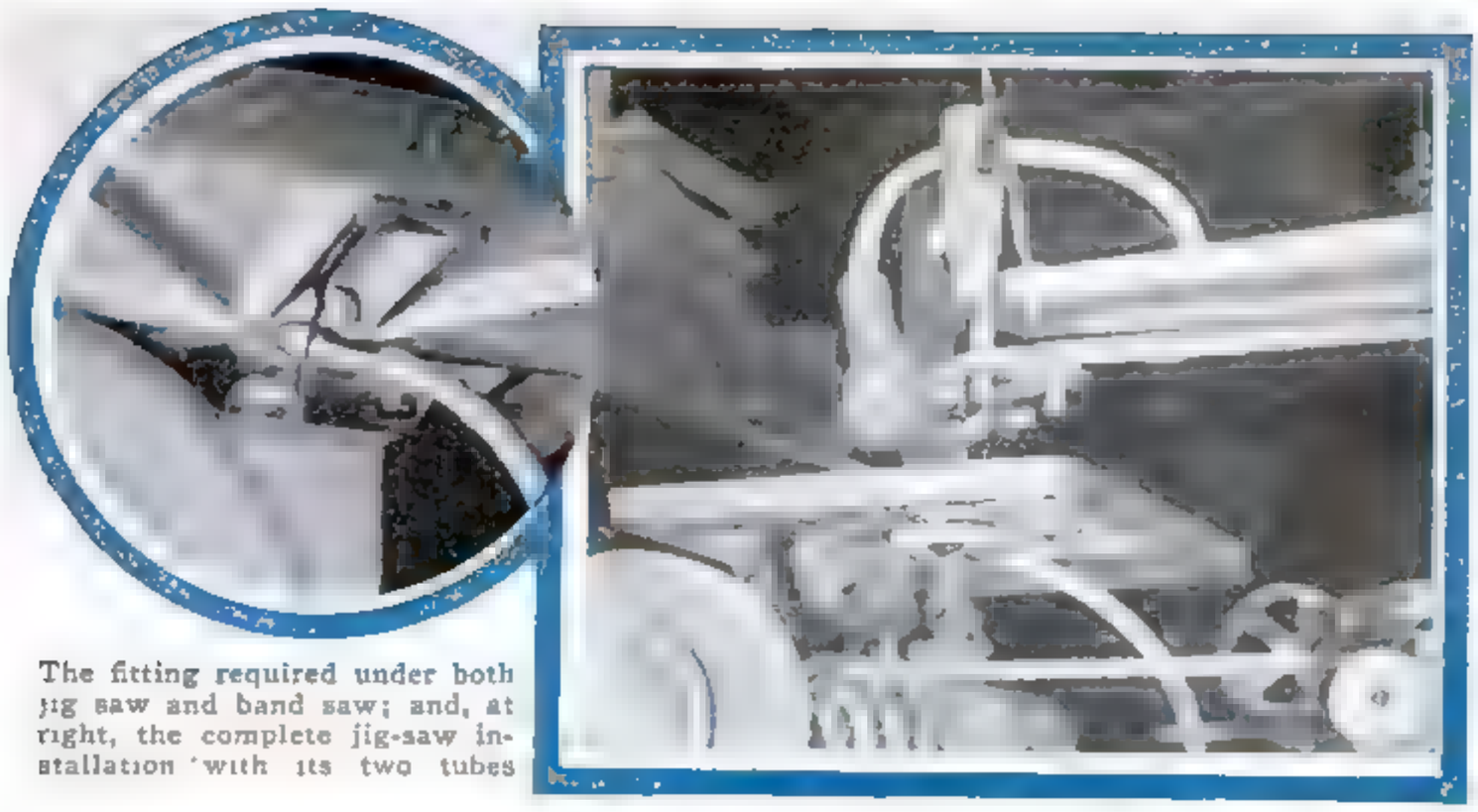
Make a wooden retainer for each end of the large spring. Place the spring and retainers over the shaft with large washers at both ends. Compress the spring so that the blocks are held firmly together, and drill a cotter-pin hole at this point. Assemble the complete valve and provide some type of control handle. This may be made as desired from any material at hand. Lay out and drill marker holes on top of the bench, and insert dowel pins cut off flush with the top.

Mount the vacuum unit in a suitable position such as shown in a photograph on the following page. Connect it so that it operates in conjunction with the desired motors.

Valve connections to the various ma-



How the valve register is made and fastened to the lower block to insure alignment of the holes



The fitting required under both jig saw and band saw; and, at right, the complete jig-saw installation with its two tubes

chines are arranged in the following way:

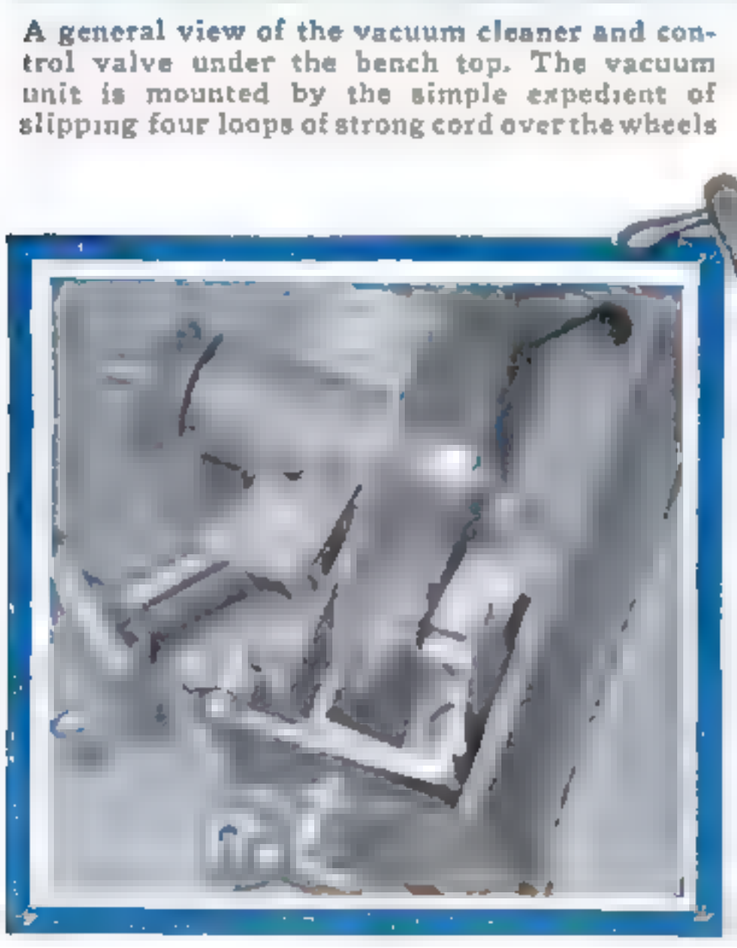
Circular saw. Remove the saw table and construct a wooden chute as shown. Cut the top at a 45-deg. angle so that it will not interfere when the table is tilted. Carefully mark where the blade will go through the side, and saw the slot so that it will just clear the blade at the sides and in its extreme lowered position. Next, as shown, cut out a piece of the side, hinge it back in position, and lock it with a wood screw. Drill a 1¼-in. hole through the bottom of the chute and bench top for the sleeve. Cement pieces of rubber on all four sides from the chute top to the underside of the saw table.

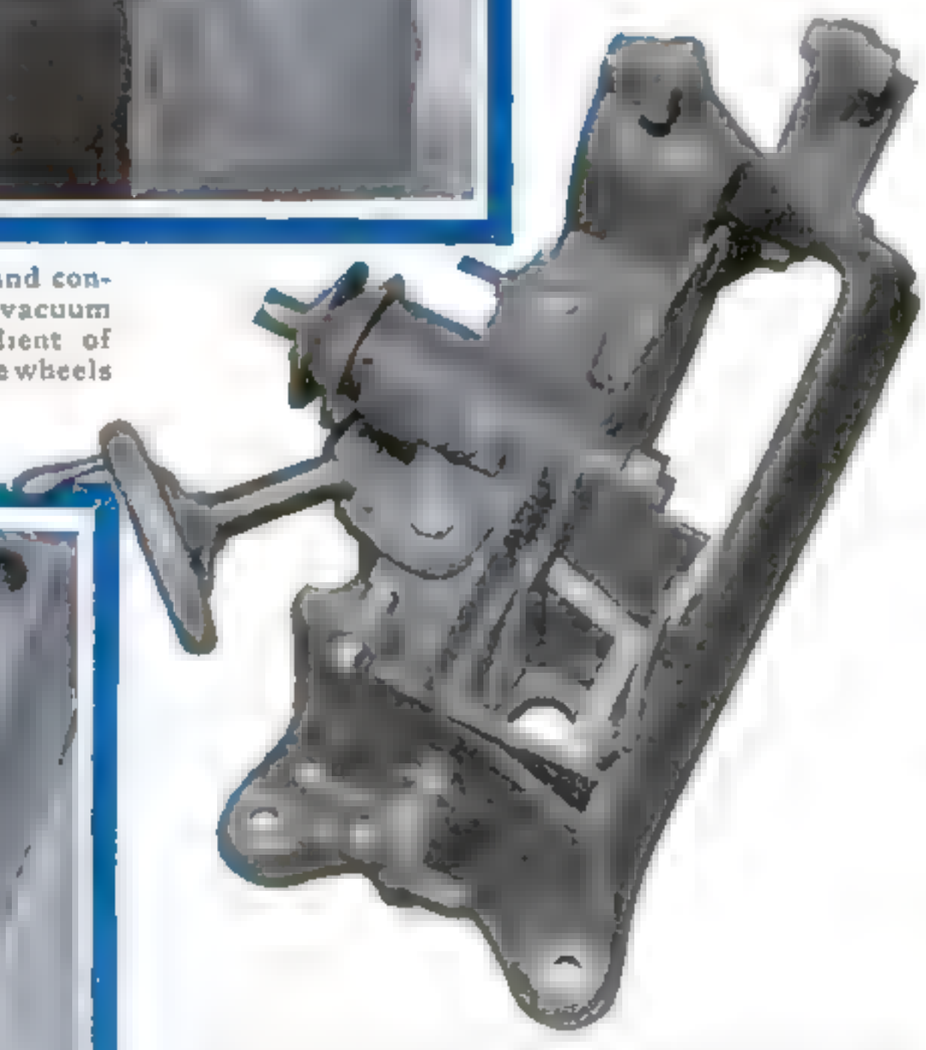
Jointer. Cut a rectangular hole through the bench top directly under the knives. Construct a shallow funnel-shaped box and mount it as indicated in the drawing below. Close up all the openings at the sides or ends of the planer with light plywood or rubber, cemented in place.

Jig saw and band saw. Remove the jig-saw table and place it upside down on the bench. Cut off the top of the bowl

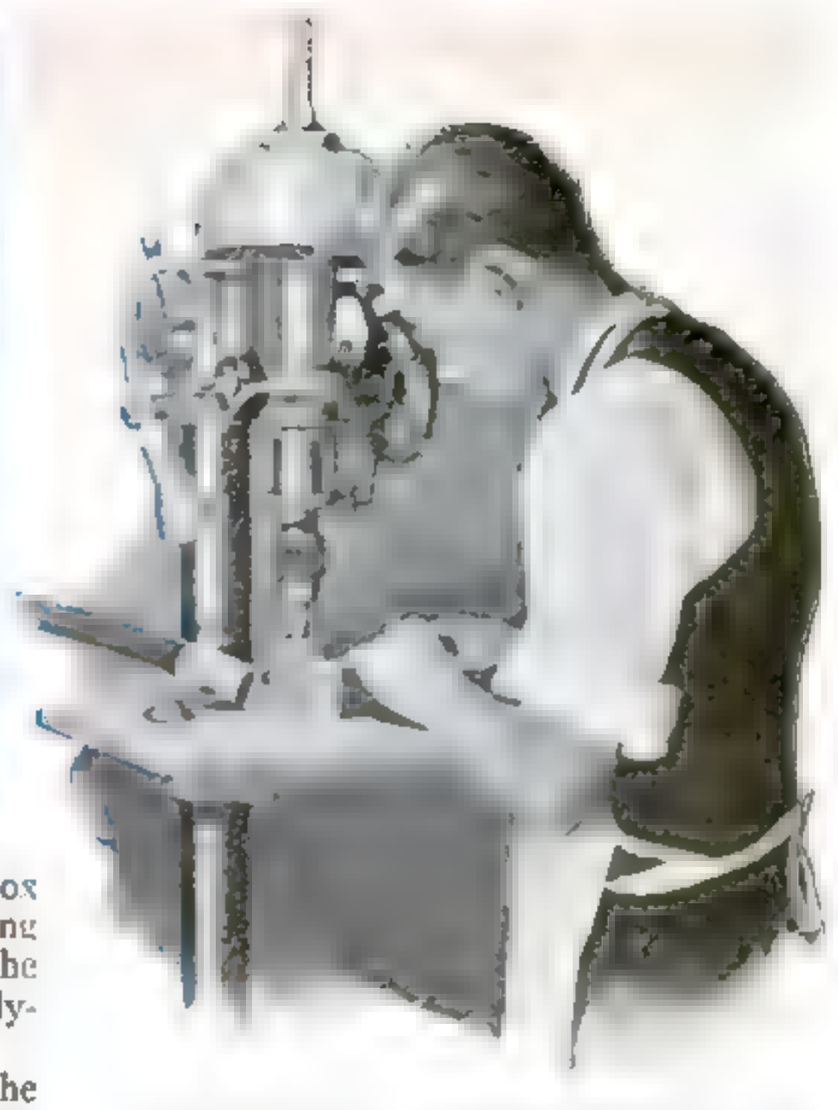
A funnel-shaped box is constructed underneath the jointer to remove all the shavings as they are made

A general view of the vacuum cleaner and control valve under the bench top. The vacuum unit is mounted by the simple expedient of slipping four loops of strong cord over the wheels





Two views of the circular-saw installation. Note that one side of the chute is hinged for removing the saw and using a dado. Rubber is cemented to top of chute to extend it to the saw-table proper



On the drill press the nozzle is held in any position necessary by means of vacuum cups

of an old straight-stemmed smoking pipe. Enlarge the stem hole as much as possible without cracking it. Cut a slot about three quarters through the pipe in the correct position for the saw blade.

From the ten-cent store obtain a sponge-rubber kneeling pad and several feet of ⅜-in. inside diameter by ½-in. outside diameter rubber tubing. Cut a 3-in. diameter sponge rubber circle with a hole through the center slightly smaller than the outside diameter of the pipe. Cement the pad in position on the underside of the table (as shown in the circle above) and insert the pipe. After replacing the table on the jig-saw, slip the rubber tubing over the stem. Run the tubing through the bench top to the valve.

For the top of the table bend a short piece of ½-in. copper tubing as shown in another photograph at the top of this page. Solder a terminal to it so that it may be fastened under a convenient nut. Slip a piece of the rubber tubing over the end and cement it in place along the frame. Run it through the bench.

Make a wooden cap to fit over one sleeve of the control valve. Drill two holes through the top of the cap for short pieces of ½-in. outside diameter copper tubing. Assemble and place the two ends of rubber tubing over the copper sleeves.

In equipping the band saw, follow the same procedure as for the lower part of the jig saw.

Sander. As this particular machine is in two sections, belt and disk, it may be connected to the valve in two ways—a separate hose to the valve for each, or as shown on page 61 with a three-way block and a single port on the valve.

Mount the nozzle to the sanding disk about 2 in. below the table and build up to the table with inner-tube rubber cemented in place.

Drill press. Obtain two suction-cup coat hangers from the ten-cent store and remove the cups. Construct a bracket to hold the end of a hose and mount the suction cups as shown in a photograph.

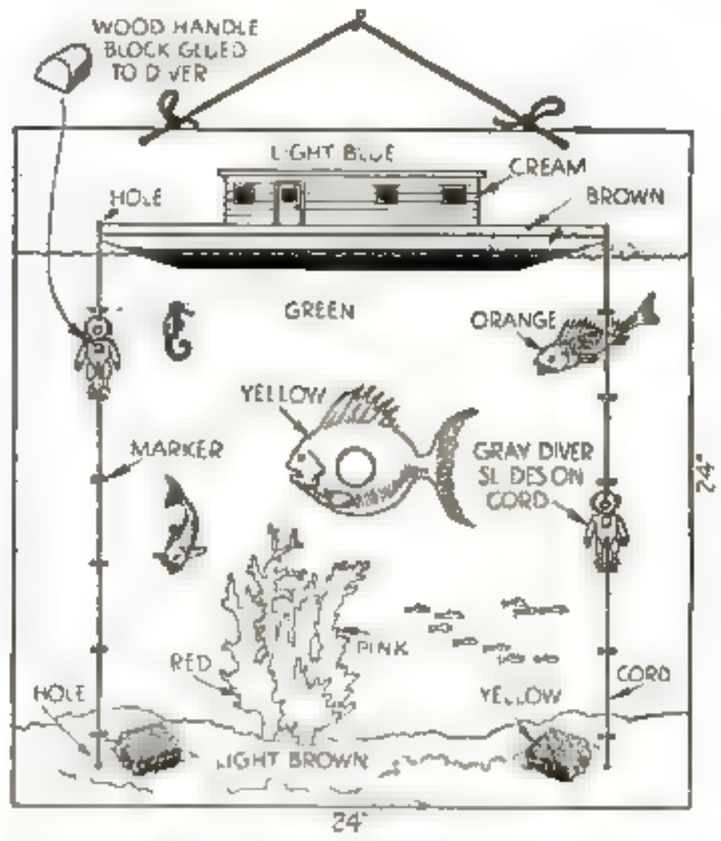
General purposes. Place an outlet on the bench where convenient.

Sunken Treasure Race Played with Toy Pistol and Darts

The object of the game is to see which diver will bring his gold to the boat first

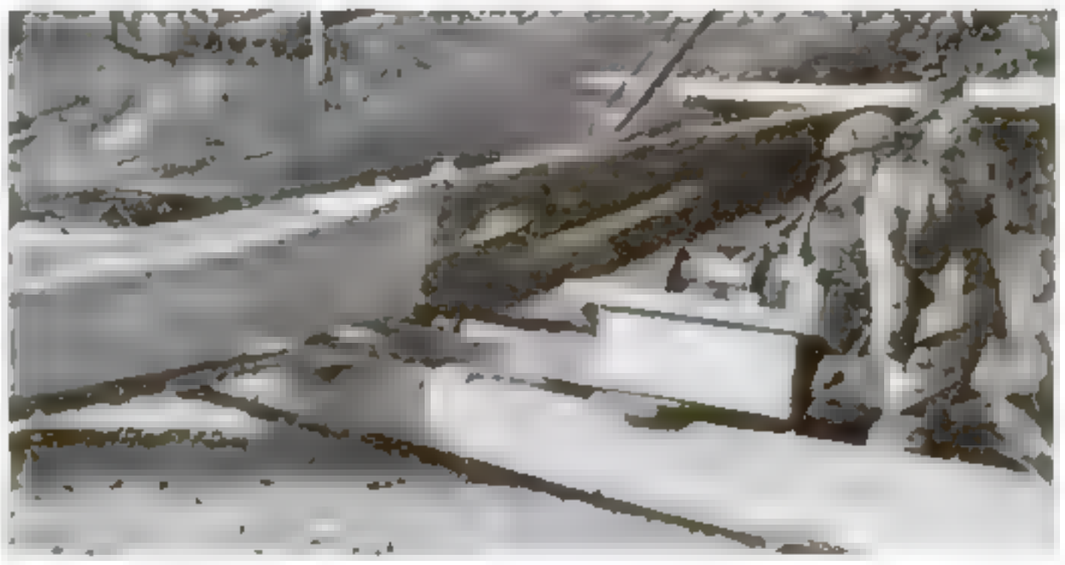
AN AMUSING game for use with toy pistols that shoot suction darts can be easily made as shown. A piece of light green cardboard 2 ft. square is used for the background, and the designs are drawn and colored. Cords are run from the ends of the boat to the sea bottom to support the divers, which are made of cardboard with a tiny piece of wood glued on to facilitate moving the figures up and down.

Two players or groups of players are needed. Each chooses a diver and slides him to the top marker. The first player aims the vacuum-cup dart at the puff fish and shoots the pistol. Three darts are used. If a dart sticks anywhere on the fish, the diver is moved down one space. If it strikes the white circle on the fish, the diver is moved two spaces. It it hits a diver, sea horse, or either of the other two fish, one more shot is allowed. When a diver has reached the bottom marker for the treasure, he is moved up the cord, space by space, until he reaches the top or starting place. The diver who comes up with the gold first, wins the race. The rules are the same for a group of players—D.W.C.



The divers move on strings attached to the green cardboard that forms the background

AUTO TRANSMISSION SERVES AS WINCH

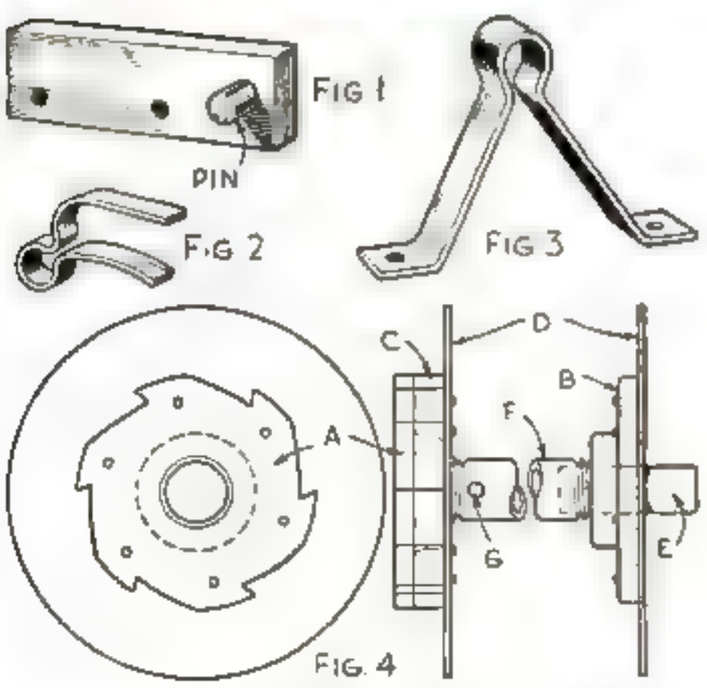


Showing how the mechanism can be used to haul a boat up a long beach onto a dock or platform

BY USING a junked auto transmission, a convenient and effective hand winch for hauling and hoisting can be made. The one illustrated was designed specifically for use in pulling a rowboat up a long beach onto a dock, but can be used also for lifting heavy loads and other similar work. It was made from a small transmission, but for heavier work, transmissions from larger cars could be selected.

The three shifts from high, second, and low adapt the winch to light, medium, and heavy loads. These changes can be made very quickly. When there is no load on the drum, the shift can be put in neutral, the rachet released, and the rope reeled off without turning the gears.

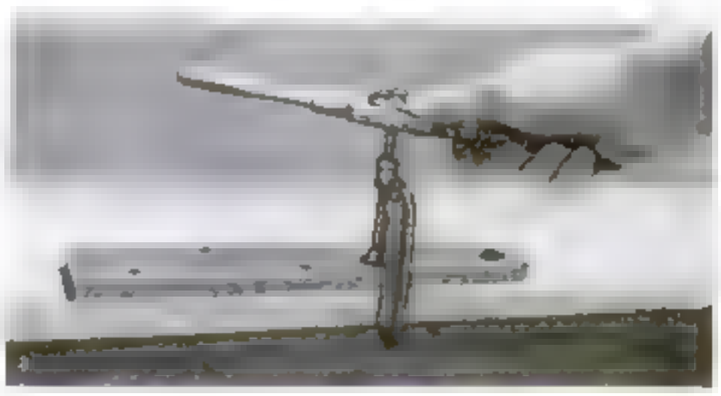
The drum, shown in Fig. 4 of the sketch, was made from a piece of 1-in. pipe, threaded at both ends, with two 1-in. floor flanges. The length of pipe is determined by the amount of rope or cable to be used on it. In order to get the flanges to screw on the pipe for their full depth, it is necessary to cut the threads on the pipe smaller than standard or to tap out the flanges. In the *(Continued on page 91)*



Only these few, simple parts are needed to adapt the transmission for use as a winch

INDEX TABS MADE WITH SCOTCH MENDING TAPE

SCOTCH mending tape of the transparent cellulose type can be used to make neat, durable index tabs. Cut narrow pieces of thin cardboard the width of the tape, write the identification on them, and then cover with the tape, leaving the ends free to attach in the proper places. Cardboard of various colors can be used for easy identification.—FRANK SHORE.



DISCARDED TAP WRENCH TIGHTENS C-CLAMPS

A DISCARDED tap wrench can be converted into a handy tool for tightening C-clamps, wing nuts, thumb screws, and screw hooks and eyes. Simply remove the tap jaws from the wrench to leave a long rectangular opening, which can be applied over the part to be turned.—W. C. W.

A beautiful charter on heavy antique paper 11 by 14 in. is given each local club by the Guild Individual affiliate cards are also issued annually to all of the club members

NOW'S YOUR CHANCE TO GET INTO THE

National Homeworkshop Guild FREE

WHERE HOME WORKSHOP CLUBS ARE LOCATED

ARIZONA
Tucson
ARKANSAS
Little Rock
CALIFORNIA
Antioch
Auburn
Bellflower
Glendale
Huntington Park
Los Angeles (Model R. R.)
Newcastle
Oakland
Pasadena
Reseda
San Diego
San Jose (2)
Santa Monica
COLORADO
Denver
Pueblo
CONNECTICUT
Middletown
Putnam
DELAWARE
Wilmington
DISTRICT OF COLUMBIA
Washington
FLORIDA
Jacksonville
Miami
Ocala
GEORGIA
Atlanta
Lake Park
IDAHO
Nampa
ILLINOIS
Chicago (5)
Cicero
Dixon
Elmhurst
Freeport
Gales-burg
LaGrange
LaSalle
Peru
Rockford
Sheffield
Springfield
Sterling
Waukegan
Western Springs
INDIANA
Borden
Evansville
Fort Wayne
Hammond
Terre Haute
IOWA
Cedar Rapids
Creston
Emmetsburg
Fort Dodge
Mason City
KANSAS
Fowler
Gaylord
Ha ton
Kincaid
Smith Center
Topeka
Wichita
Winfield

(See page 101 for continuation of list)

IF YOU know five or six persons interested in the home workshop hobby, why not organize a club and become affiliated with the National Homeworkshop Guild? The Guild is now able to offer its services to all such clubs without charging any dues whatsoever.

At the left and continuing on page 101 is a list of cities and towns where home workshop clubs are located. If you live in one of these places, the Guild will gladly send you the name and address of the secretary of the local club. Please inclose a self-addressed, stamped envelope with your request for this information.

In some cases there are two or more clubs in one city. The Guild believes in encouraging neighborhood clubs in which the members can enjoy friendly companionship in their hobby without going far from home; consequently you need not hesitate to start a club even though another group is already established elsewhere in your city.

Complete information on how to organize a club and an application blank may be obtained by filling out the coupon on this page. A charter like that illustrated above and individual affiliate cards for each member will be mailed to you as soon as your application has been received and approved by the directors of the Guild.

You will find the instructions smooth away every difficulty you are likely to encounter in conducting a club. The only conditions with which a club must comply are: (1) A minimum membership of five and a minimum age limit of sixteen years. *(Continued on page 101)*

National Homeworkshop Guild
347 Fourth Avenue, New York

I'd like to organize a home workshop club. Without cost or obligation, please send me complete instructions and tell me how to get others to join, how to find a good place to meet, how to obtain publicity, how to conduct meetings, and so on. Include a copy of a model constitution and an application blank for a free charter in the National Homeworkshop Guild.

I am inclosing a large (legal size) envelope, self-addressed and bearing a three-cent stamp for your use in sending all this material.

NAME .....

ADDRESS .....

CITY..... STATE .....

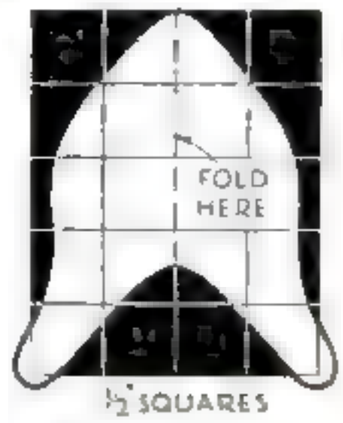
(Please print very clearly)

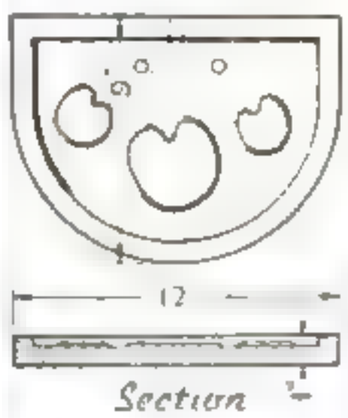
FOUR NEW ANSWERS TO YOUR QUESTION: What

CAT-TAIL LAMP HAS LILY POOL FOR A BASE

This unusually novel little lamp resembles a lily pool in miniature

The surface of the pool is routed away on the drill press so the lily leaves stand out in slight relief





WHEN winter has turned the water in the lily pool to ice, it brings back happy memories to have a lily-pool lamp in your living room. The soft radiance shed by the stately cat-tails spreads a mantle of light and shadow over the lily leaves, the arrowleaves, and the tall rushes, while a white swan floats idly on the still water.

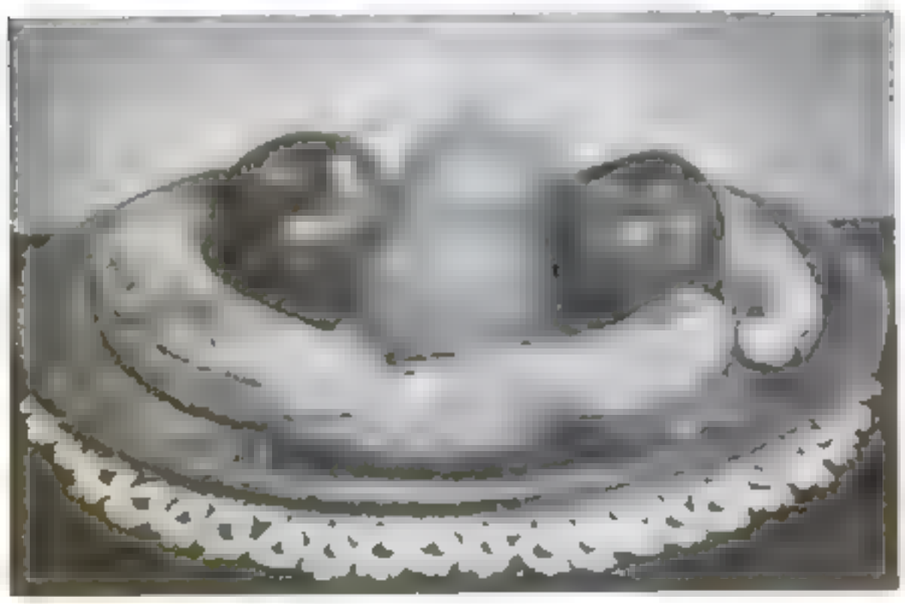
This unusual little lamp is a one-evening job except for the painting, and it is made mainly of scraps that cost nothing. The base or pool is laid out on a piece of softwood 9 by 12 in. and sawed on the band or jig saw. The rim is then marked off, and the whole surface inside the rim is cut down 3/16 in. with a router bit in the drill press. When it has all been cut away, the lily leaves are marked out, the router is lowered 1/16 in. more, and the surface is again cut down to make the leaves stand out in slight relief.

The wall along the back is next cut out. The rocks on it and around the rim of the pool are outlined with a carving bit in the drill press or with a hand veining tool. The two pieces are then fastened together with screws through the bottom into the back.

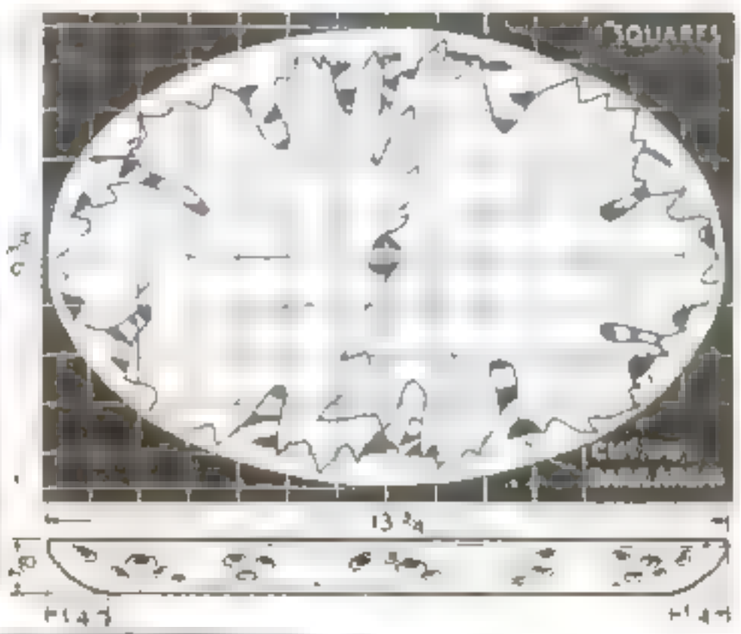
The cat-tails are next made. The leaves will be more durable if of sheet metal. Strips are cut to shape with tin snips, and the lower ends are rounded over a ½-in. round rod with a ball-peen hammer. When the leaves for one plant have been finished, a metal band is *(Continued on page 91)*

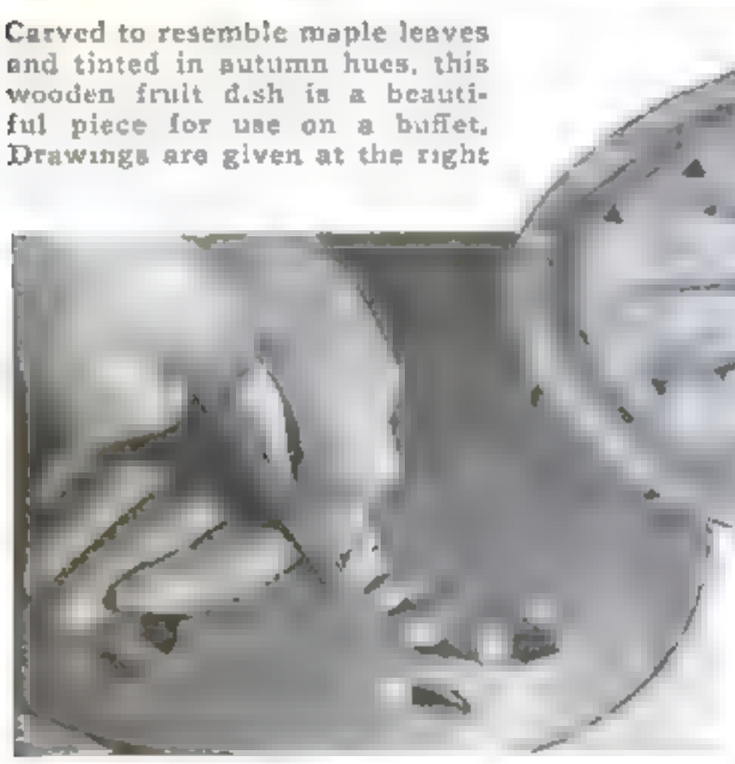
The flat strips for the cat-tail leaves are bent over a rod so they will fit the stems, which are of two-wire, lead-covered cable

DECORATIVE FRUIT DISH CARVED IN FORM OF MAPLE LEAVES



Carved to resemble maple leaves and tinted in autumn hues, this wooden fruit dish is a beautiful piece for use on a buffet. Drawings are given at the right





The openings are pierced with a jackknife and beveled on the underside with a gouge

IN THIS pierced and carved fruit dish, the vivid hues of autumn maple leaves are tempered with a somber brown, giving an air of warmth and informality.

An evenly grained, moderately hard wood is used, such as birch or whitewood. The stock size is 9⅜ by 13¾ by ⅞ in. The first step is to rough out the interior with a short-spurred bit or one of the special bits having no spur. Follow carefully the line of the interior as shown in the drawing and leave a minimum of ⅜-in. thickness in the bottom of the block. With a gouge or flexible-shaft router, go over the rough borings.

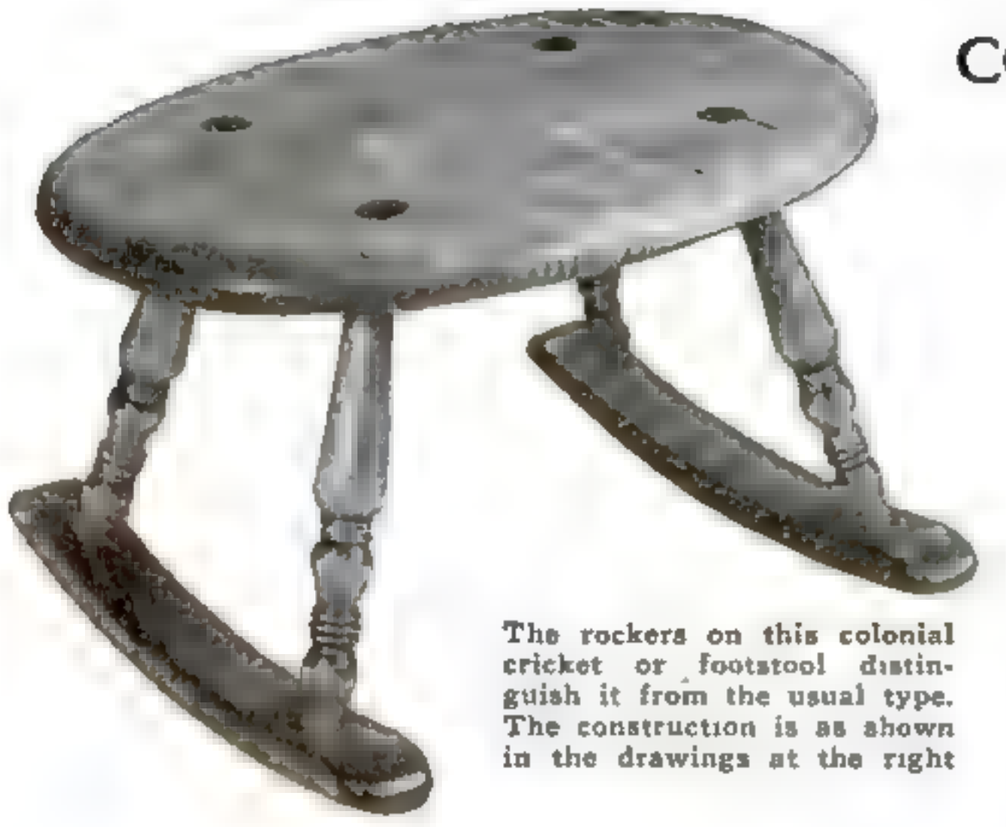
From a layout pattern of the maple leaves, trace the details on the wood. All the leaf edges are cut in relief, 1/32 in. above the adjacent wood. Make high and low spots in the leaves and slope the edges of these gracefully to give a billowy, symmetrical form. Sand out all but the smallest gouge marks, which are left to give a hand-tooled finish.

With the inside woodcutting done, clamp the saw table at a convenient angle and cut along the oval outline. Lightly true up the contour of the underpart, finishing to a 1¼-in. overhang. The pierced openings, shown in black in the drawing, are made with jackknife and small gouge.

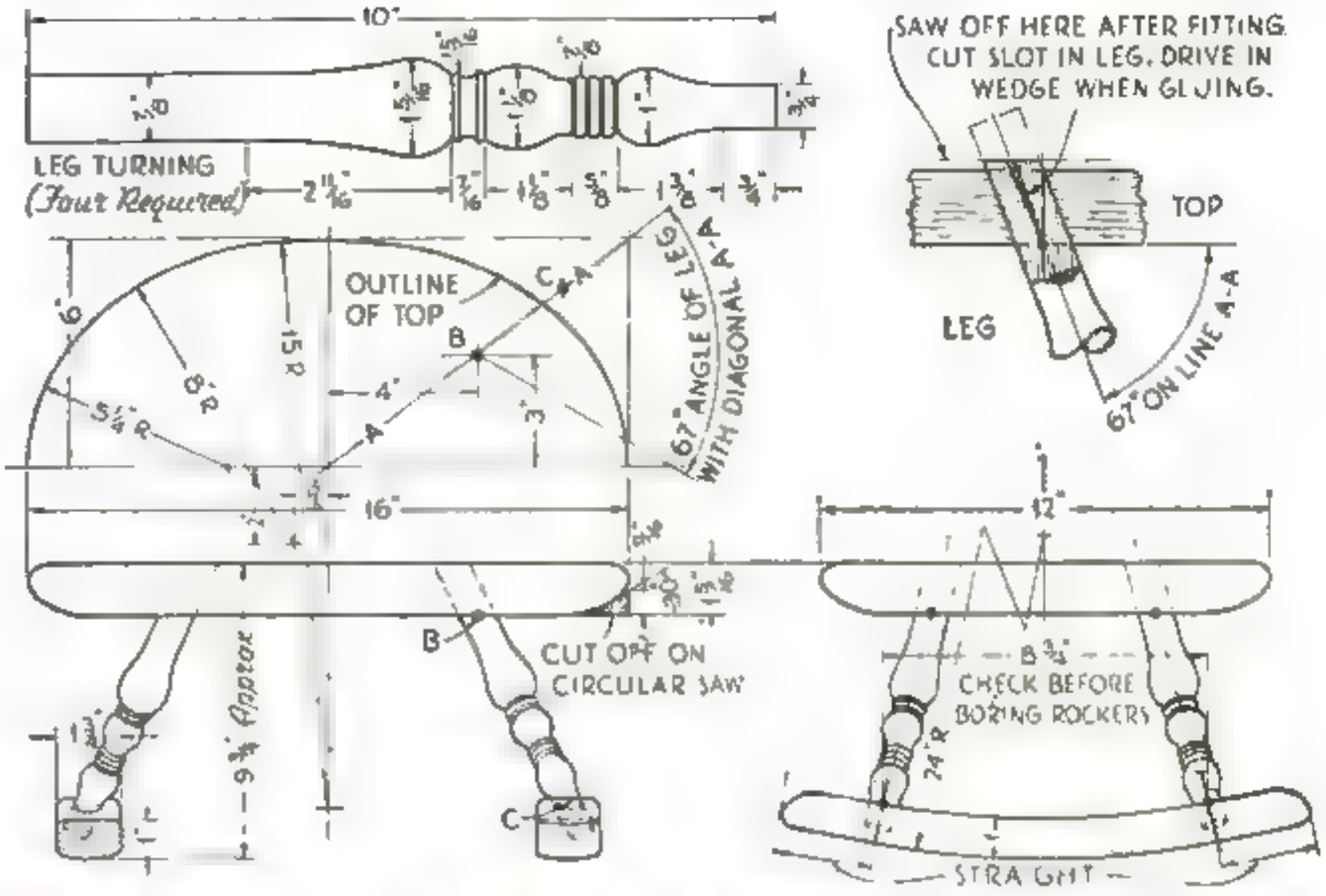
Small wads of absorbent cotton are dipped in weak paint and used to apply the fall colors to the leaves—green, red, yellow, orange, and brown, with yellow and red predominating. Stain the balance of the dish evenly with walnut color. When all surfaces are dry, apply wax lightly with a clean cloth.—D. W. PRINCE.

Shall I Make Next?

COLONIAL CRICKET WITH ROCKERS



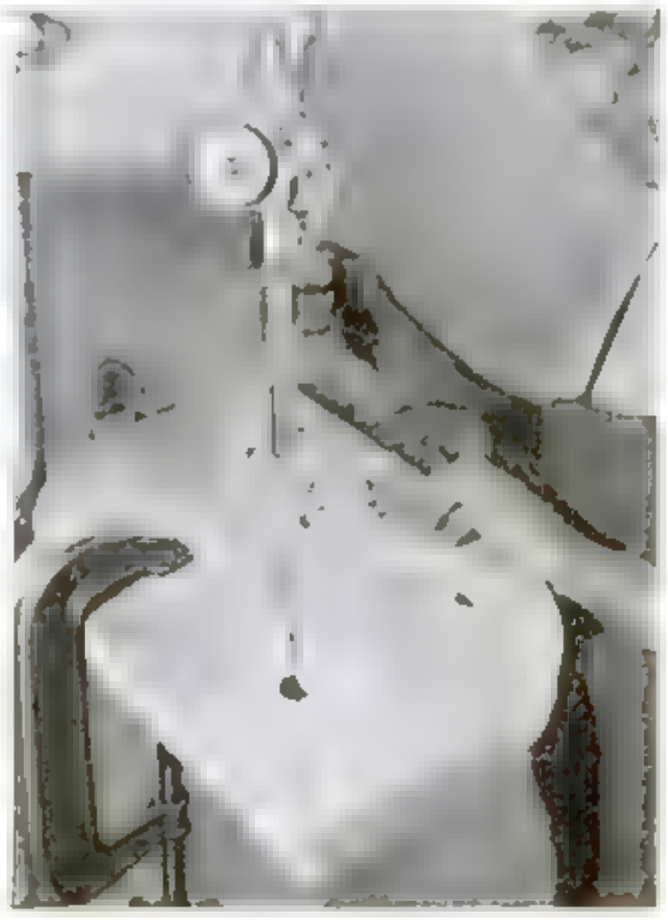
The rockers on this colonial cricket or footstool distinguish it from the usual type. The construction is as shown in the drawings at the right



ROCKERS set this cricket or footstool apart from the ordinary variety and make it doubly attractive to small children. Since the design is of Early American origin, the wood selected should be maple. If a distinctive effect is desired, pick out a piece of wood for the top having a fiddle-back figure. As it will probably be necessary to buy it in narrow widths in order to get figured grain of even color, it will be necessary to glue up three or more pieces to make the 12 by 16-in. top. Use a tongue-and-groove or spline joint and waterproof glue for the best results.

Square up the block and lay out the center line and diagonals *A-A* (see drawing). Locate on the bottom side the points *B*, where the holes for the legs are to be bored. Tilt the drill-press table to 67 deg. and clamp the top on it with the diagonal line running directly down the slope. Placing a waste piece of wood under the block to prevent injury to the boring tool. A bit of the Forstner type does the best job with this set-up, if available. However, if a small pilot hole is first made with a twist drill, the large hole can be made with an ordinary brace bit used in the drill chuck, provided the square shank has been sawed off. In thus *(Continued on page 95)*

Because of its irregular grain, the figured maple is finished by scraping and sanding. The leg holes are bored in the top by tilting the drill-press table as illustrated at the right, although this may be done by hand

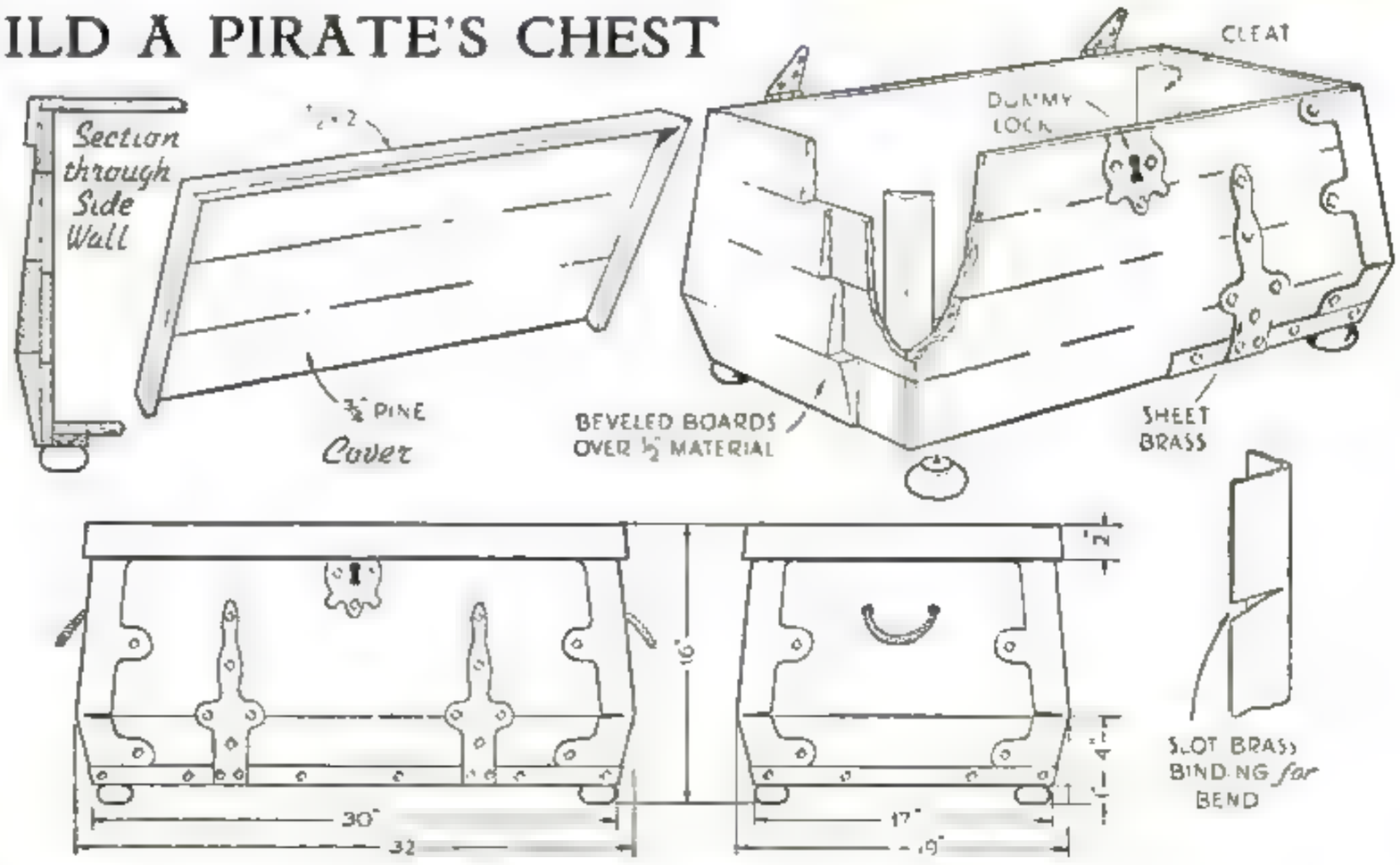


EASY WAY TO BUILD A PIRATE'S CHEST

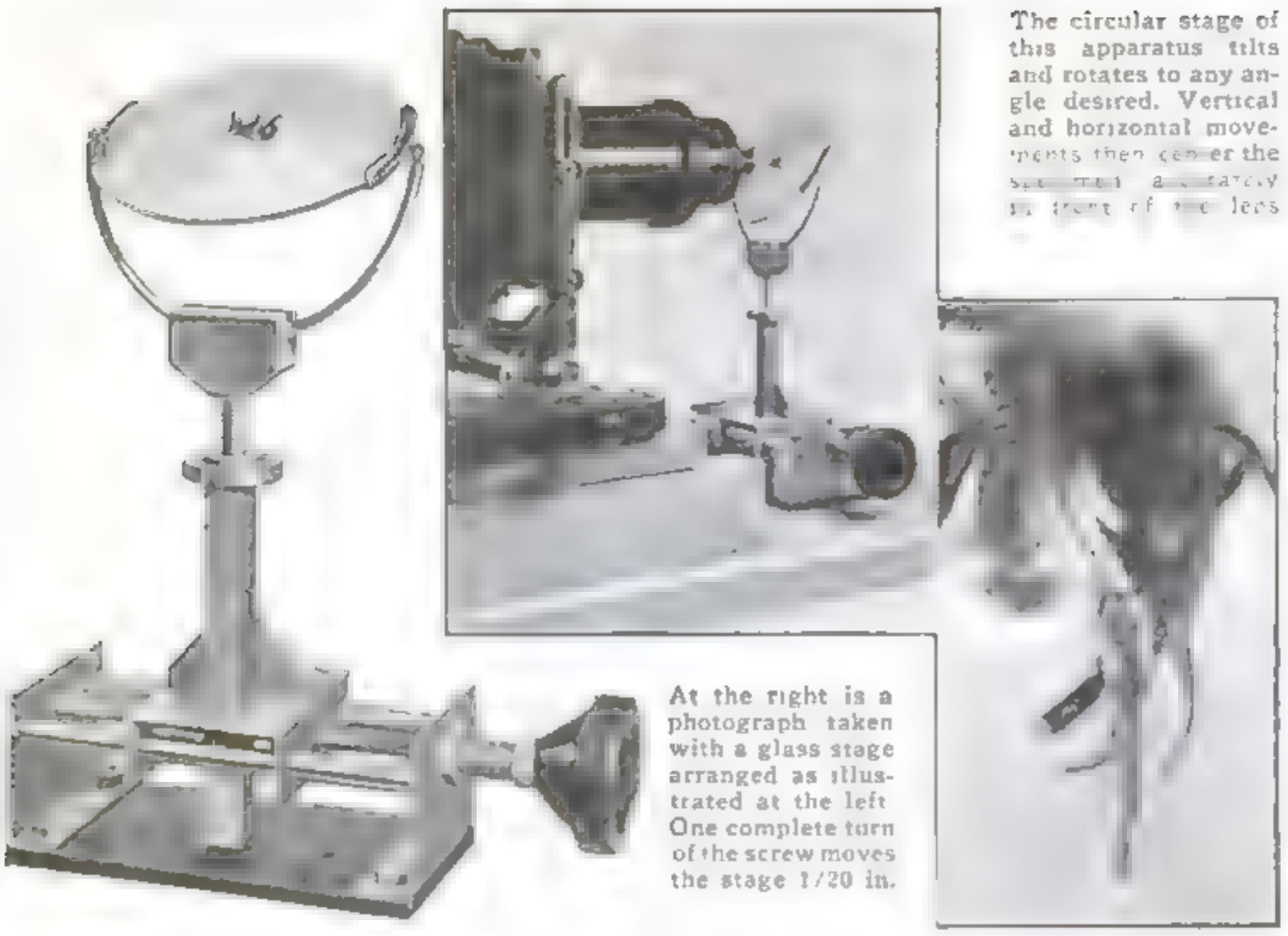
ALTHOUGH no one would suspect it from the finished appearance, this pirate's chest is very easy to build. The swelling sides are obtained simply by applying beveled boards over an ordinary box of ½-in. thick pine or other wood. The corner construction and mitering therefore offer no difficulties, even to the beginner.

The chest is bound at the corners with brass or copper cut in the design shown and secured with square-headed upholstery nails. The keyhole is only a dummy, unless you wish to install a chest lock.

The wood is finished in the color of driftwood, which is attractive with burnished brasswork. To obtain such a finish, apply a prepared driftwood stain and dust on rottenstone powder to give the desired antique effect. Dimensions may be altered if a larger or smaller chest is desired.—H.S.



Front and end views of the chest, a section through the wall, and sketches to show the construction



The circular stage of this apparatus tilts and rotates to any angle desired. Vertical and horizontal movements then center the specimen accurately in front of the lens

At the right is a photograph taken with a glass stage arranged as illustrated at the left One complete turn of the screw moves the stage 1/20 in.

GLASS STAGE FOR PHOTOMICROGRAPHS

THE amateur interested in photomicrographs will find this movable glass stage of great help in taking pictures. The circular stage tilts and rotates so that the specimen can be viewed from any angle. Centering is accomplished by vertical and horizontal movements. With the instrument illustrated, one complete turn of either adjusting screw moves the stage 1/20 in. which, when magnified ten diameters, is ½ in. on the ground glass.

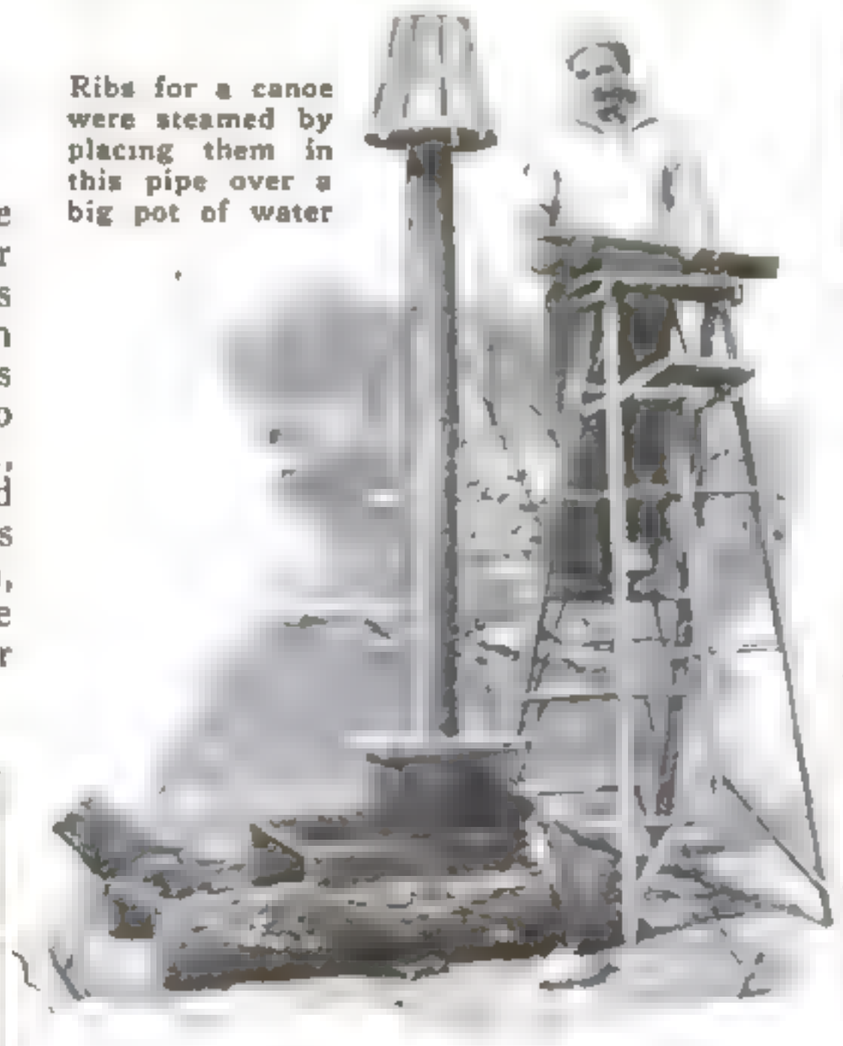
Made from a ten-cent picture frame, the stage and its holder are mounted on a short screw set into a piece of square brass rod, which is an easy sliding fit in a square brass tube attached to the horizontal carriage. The base can be made from scraps of brass angles, rods, and radio parts.

The dimensions are not critical because a movement of more than 1 or 2 in. is not necessary, although the vertical rise can be more to suit various lens heights. A simple track mount for keeping the camera in line with the stage is a help.—B.G.S.

LATHE INSPECTION DATA KEPT IN GEAR COVER

LATHE owners who take pride in the accuracy of the work turned out in their machines should keep a record of the tests and other operations made to maintain precision. A card inside the gear cover as shown below forms a convenient place to record the dates when center alignment, lathe level, cleaning of lead screw, and other checks and maintenance operations are performed. To keep this card clean, have it fit in a pocket formed by a piece of celluloid attached to the gear cover with adhesive tape.—B.K.

The card recording all inspection data is slipped into a transparent celluloid pocket



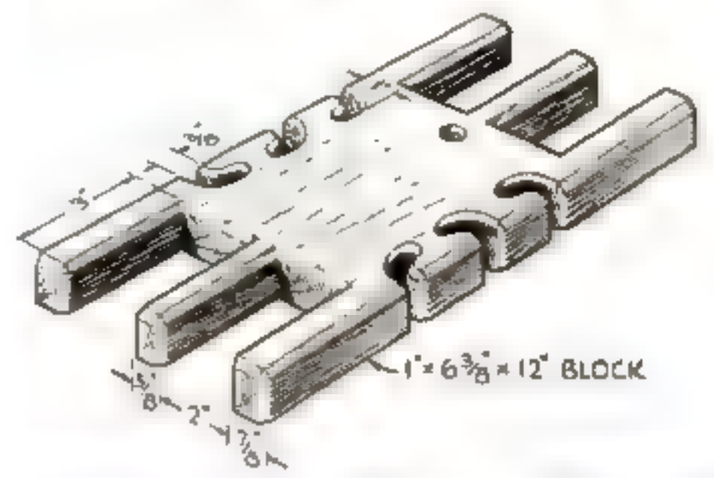
Ribs for a canoe were steamed by placing them in this pipe over a big pot of water

STOVEPIPES FORM STEAM BOX FOR BENDING RIBS

IN THE construction of a canvas sailing canoe, it was found necessary to steam all the ribs. By mounting several lengths of stovepipe over a pot of water, a very simple and effective steam box was obtained. The ribs were inserted and removed from the top, and a basket was used to regulate the escaping steam. Three guy wires from the top held the pipe upright. The source of heat is optional—ALFRED C. EITEL.

EXTENSION CORDS WOUND ON WOODEN SHUTTLE

ELECTRIC extension cords coiled on shelves or looped over nails are almost certain to tangle, and this shortens the life of the wire. A simple reel or shuttle on which to wind the cord can be made in a few minutes as shown. Use 1-in. lumber, and chamfer or round the corners to prevent damaging the insulation. The three small center notches at the sides are used for catching the plugs and socket ends.



Only a few minutes are needed to make this simple wooden shuttle for extension cords

MACHINE FILE FINISHES JIG-SAWED CURVES

MACHINE smoothing of small inside curves of scroll-sawed pieces is not done very satisfactorily with small sanding drums, for the sandpaper soon clogs and becomes worthless. However, curves down to ⅛-in. radius can be smoothed quickly with a ¼-in. round machine file made for use in motor-driven scroll saws. Insert the file in the chuck of a drill press, clamp the quill, and run at highest speed. Slide the work slowly past. The teeth of the file can be cleaned with a file card

By using a machine file in the drill press, you can easily smooth small, inside curves

Captain E. Armitage McCann *tells how to build*

A MODEL OF FAMOUS OLD

Barnegat Lighthouse

MORE than two thousand years ago an Egyptian king, Ptolemy II, built a tower on the island of Pharos, near Alexandria, which is said to have been 500 ft. high. On this tower was placed a fire so that his ships, by day or by night, would be guided into their safe harbor. That is the first lighthouse of which we have record. Ever since, lighthouses have been erected and improved until now every coast throughout the world has these beacons to guide those who go down to the sea in ships.

To make a lighthouse model is an enjoyable project of no great difficulty, and there are many interesting and picturesque lights from which to choose. I finally decided on Barnegat Lighthouse on the New Jersey coast for these reasons: it is one of the oldest and best known in America; it has a flashing light; it stands on a sand dune, which makes a good base; it can be separated from surrounding buildings; and it has a few picturesque trees close by.

A steady, fixed light is, of course, the simplest type to install. With this the lighthouse could stand in a window, light up a dark corner, such as on a stairway, or be a useful night lamp. Some lighthouses have a fixed light.

It is best to get the lamp first and make the lantern, because on them will depend the size of the tower. Suitable 7-watt

Looking down on the model. It is 10½ in. high on a base 5 by 8¾ in.

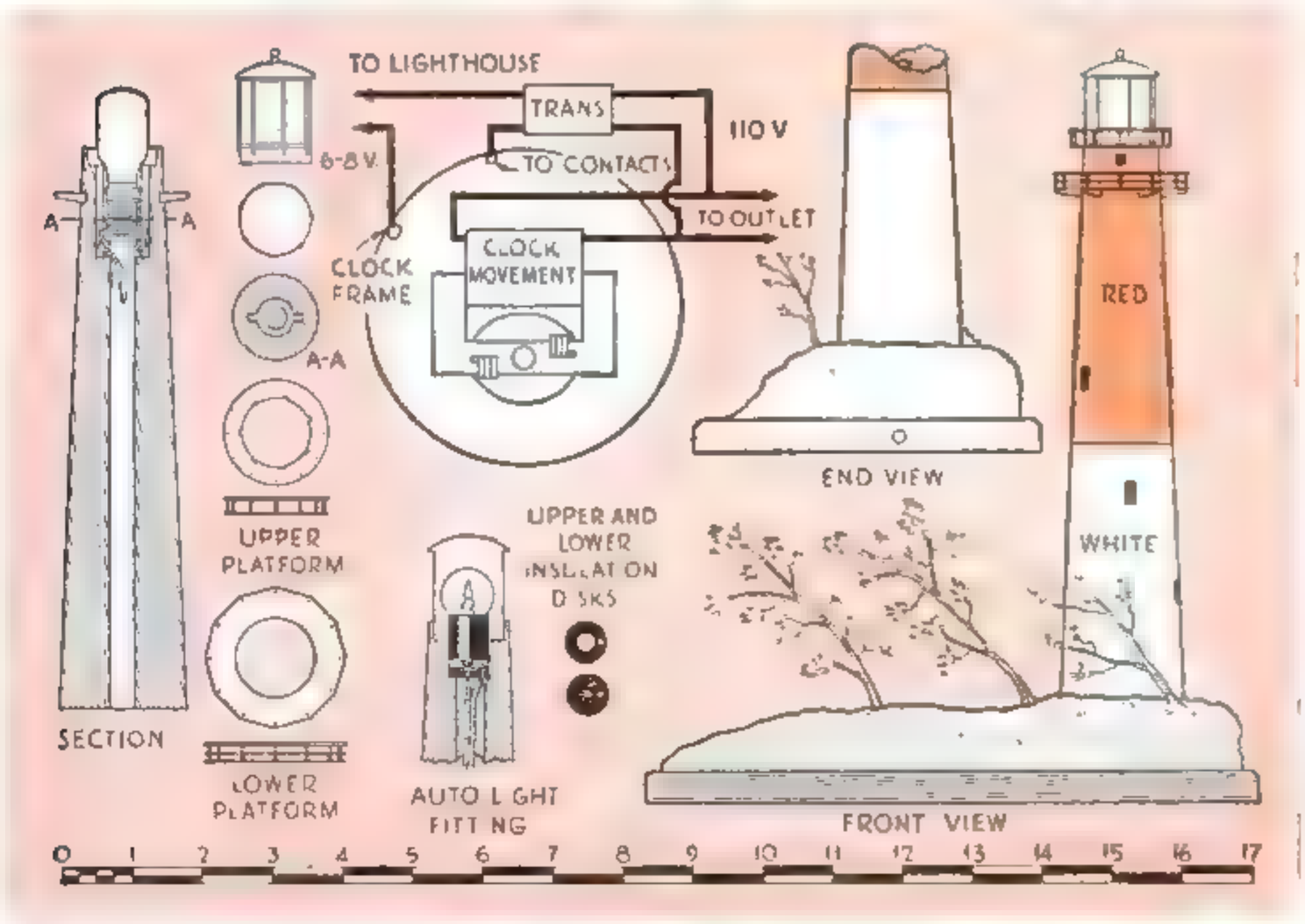
The miniature Barnegat Light from the front or seaward side. The dune is carved from pine and coated with glue and sand

electric lamps with sockets can now be bought at the ten-cent stores, but I found a frosted-glass lamp of the same diameter which I like better.

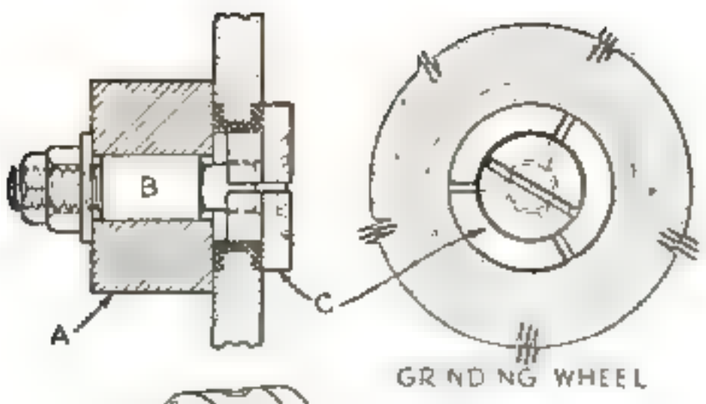
The lantern is a tin tube just large enough to be an easy fit over the lamp. I used a section of a sample tooth powder can just 1 in. in diameter. The visible part is 1 in. deep, but with another ¼ in. to be set into the tower. Cut away not quite half the circumference, leaving rims at top and bottom. (If you put the tube on a broomstick, the horizontal cuts can be made with a hack saw and the vertical cuts with tin snips.) Solder on seven thin tin bars as shown.

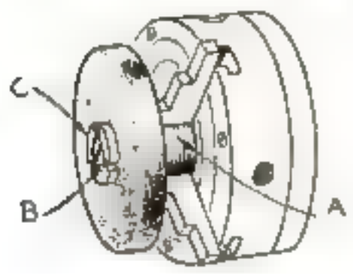
Hammer another piece of tin to form the dome top and still another for the vent cone; solder these on, and then a ball of some sort, which may be a ball-bearing ball or perhaps a glass-headed pin with the shaft soldered. A piece of clear celluloid, such as is used in photoframes, can be bent into a tube and snapped inside to form the glasses.

The tower is a round, tapered stick about 8 in. long. Its diameter at the top is ⅛ in. larger than the lantern—in my model 1⅛ in. The base diameter is about 11/16 in. greater. At the top, preferably before tapering *(Continued on page 108)*



Views of the assembled model; details of the tower proper, the lantern, the platforms, and other parts, with a scale in inches; and a wiring diagram for the clockwork flashing device, if used





GRINDING TOOL BITS IN LATHE

TOOL bits or cutting tools may be ground, when necessary, in the lathe by mounting the grinding wheel as illustrated above.

The device for clamping and centering the wheel consists of a screw *B* and three clamping segments *C*, which are made from round stock, drilled and counterbored. The outer shoulder is made concentric with the center hole, then slit into three parts. When the grinding wheel is in place, screw *B* is tightened, and the tapered end of the screw expands the segments until the wheel is clamped securely against the steel bushing *A*. The body of the screw must fit snugly in the bushing to center the wheel.—P. E. VERAA.

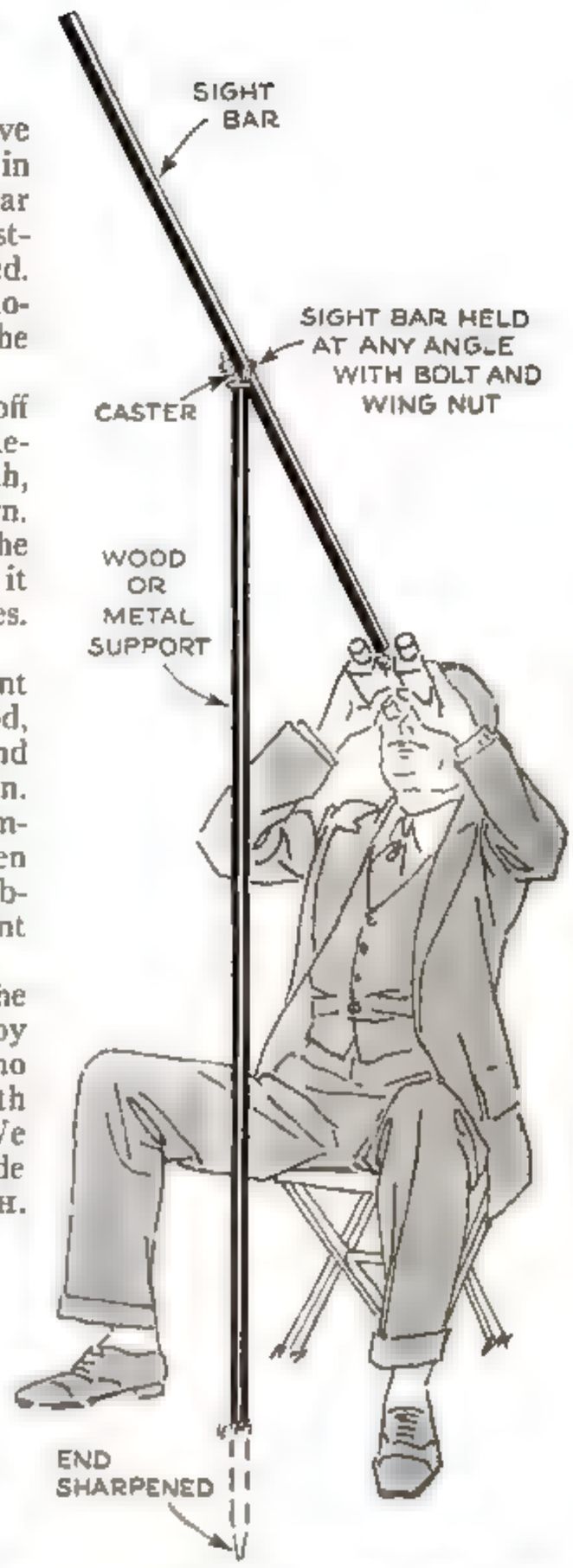
WOODEN STAR SIGHTER AIDS IN STUDYING ASTRONOMY

PROBABLY other students of astronomy have encountered the same difficulty that I did in pointing out to another observer some particular third to sixth magnitude star, faint planet, interesting double, or in fact any object not easily located. In a few minutes a fellow student and I put together a star sighter like that illustrated at the right, and this solved the problem for us.

Take an ordinary chair or bed caster and file off the rivet that forms the axle for the wheel. Remove the roller and in its place mount a smooth, straight stick of wood 3 or 4 ft. long, as shown. Trim it to a snug fit between the prongs of the caster, drill a hole through it, and then secure it with a bolt and wing nut through the rivet holes. This forms the sight bar and swivel table.

Our star sighter was for outdoor use, so to mount it we obtained a 6-ft. length of 1 by 1-in. wood, drilled a hole in one end for the caster pin, and sharpened the other end for driving into the lawn. A length of metal tubing of sufficient inside diameter to take the caster pin snugly would be even better. For use on a roof top or any solid substance, it is easy to make a cross-bar arrangement to serve as a base for the upright.

In operation, the instructor swivels and tilts the sight to point to the desired object and locks it by tightening the wing nut. The student then has no difficulty in spotting and picking up the object with the naked eye or with binoculars if desired. We have also been using this star sighter to provide evening guests with entertainment.—K. F. KEITH.



One observer sets the pointer; then others merely sight along it to locate the star

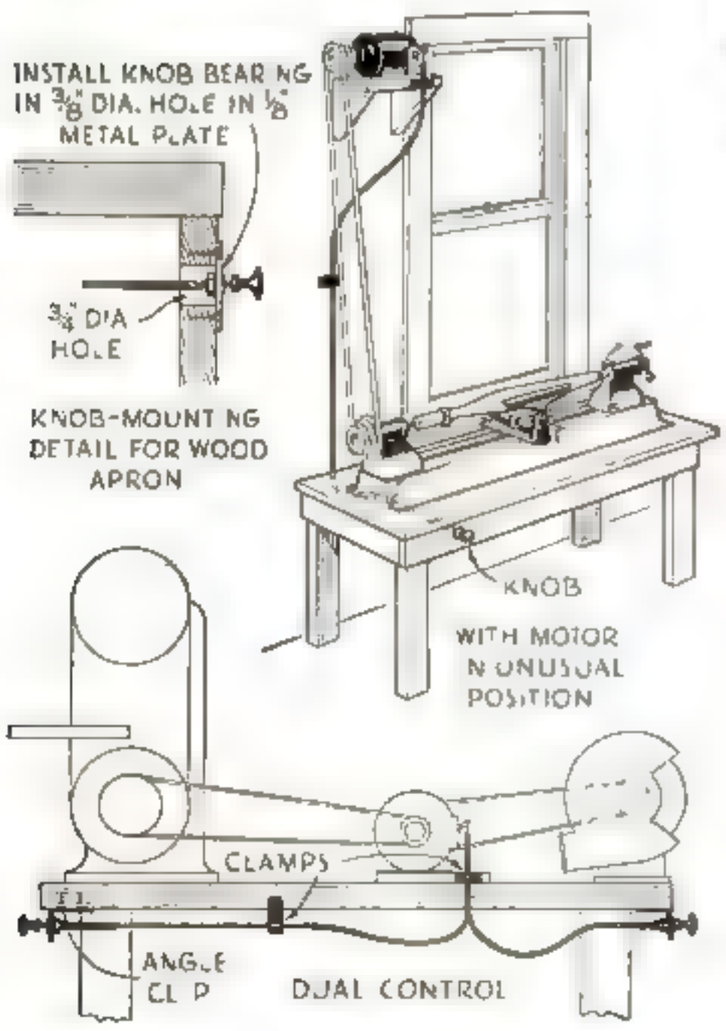
CONTROL FOR UNHANDY MOTOR SWITCHES

SMALL home workshop motors are often supplied with built-in toggle switches which, if inaccessible to direct control by hand, can be operated by an arrangement of rods, guides, and levers. The push-pull knobs that control the spark and gas on automobiles through a flexible cable are particularly suitable for this purpose.

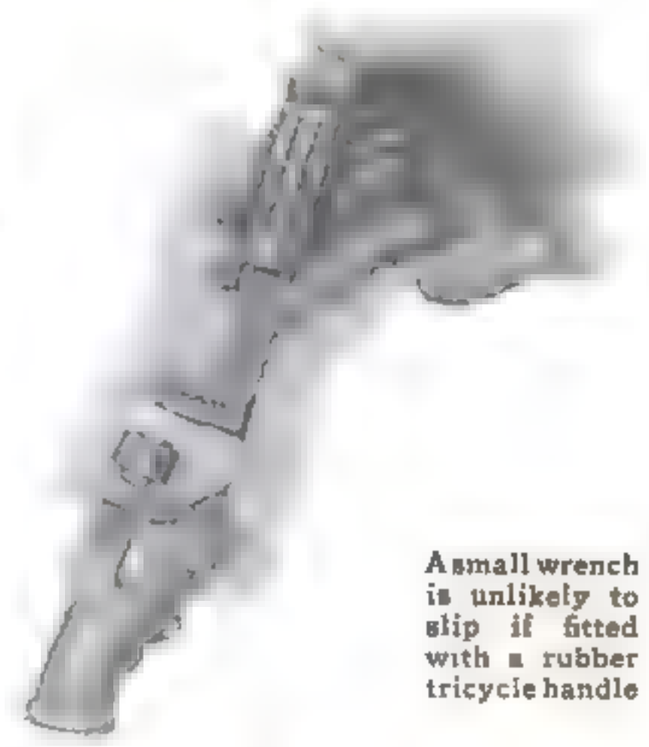
The accompanying photograph shows the application to a motor driving a scroll saw. The knob bearing was mounted in the stand leg through a ⅜-in. hole drilled in the metal and secured with the lock washer and nut furnished with the cable. The push wire and casing were cut off to the proper lengths, the wire hooked into the switch arm, and the casing rigidly supported with a small clip slipped under the motor. As installed, the motor is on when the knob is pulled out. It can be shut off by pushing with the knee in case both hands are needed for holding the work.

Suggestions for meeting various possible conditions are given in the diagrams at the left.—JOHN P. ADAMS.

The switch of this scroll-saw motor is controlled from the front of the machine by means of a flexible cable



Suggestions for operating the toggle switch of a motor when it is relatively inaccessible



A small wrench is unlikely to slip if fitted with a rubber tricycle handle

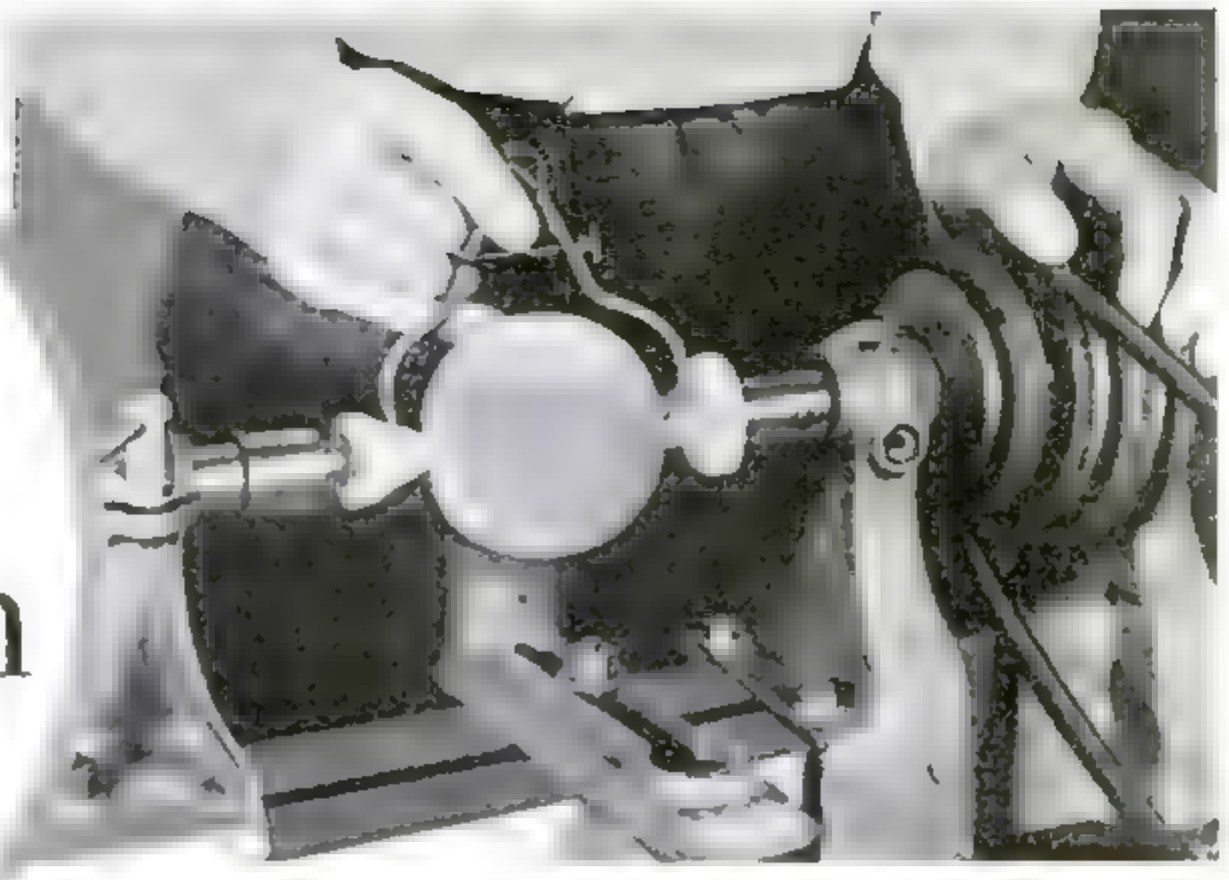
RUBBER GRIP ADDED TO SMALL WRENCH

A RUBBER tricycle handle forced over the grip of a small wrench will make it much easier to hold when working at close quarters or when the wrench is coated with oil. The rubber handle, which costs little, should be pushed firmly over the wrench handle. Small, flat sticks are then used to fill in the gap to make an unyielding grip.—FRANK BENTLEY.

NEEDLE FOR BURLAP AND CANVAS MADE FROM CAN-OPENING KEY

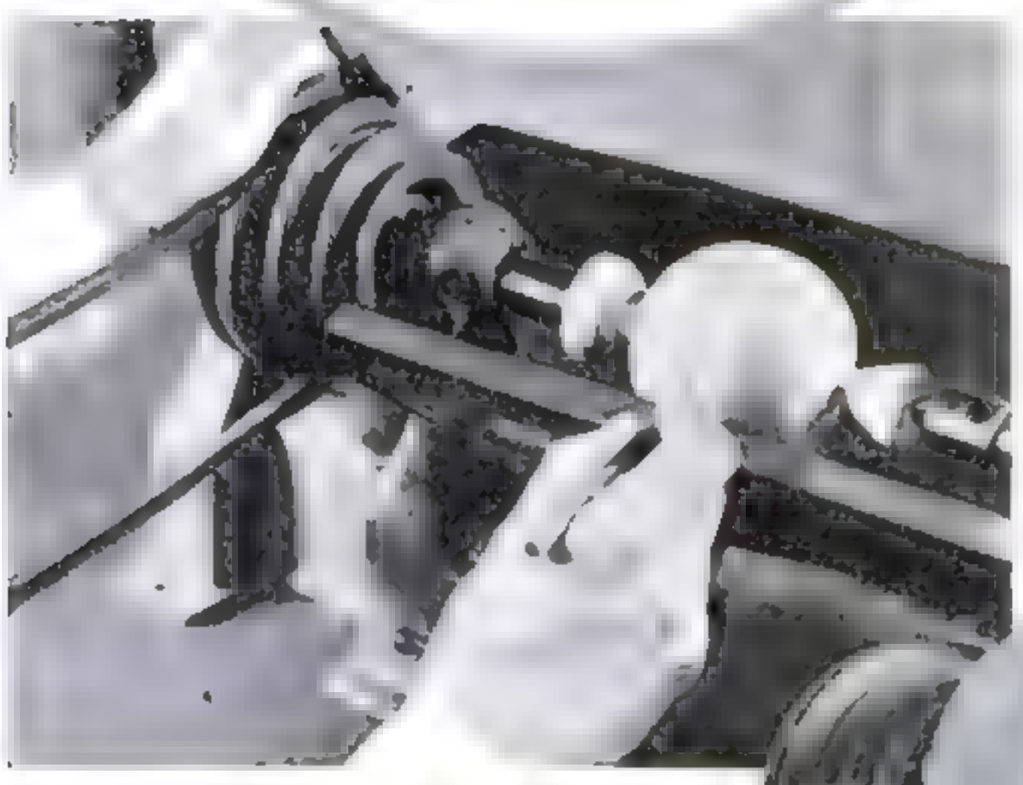
WHILE on a camping trip we needed a heavy-duty needle with a large eye for sewing burlap and canvas, and found that a can-opener key serves the purpose very well. Simply straighten out the handle part of the key and file that end to a sharp point.—BENNIE KIRBY.

An Easy Way to Turn True Wooden BALLS



In making wooden balls for various bowling games, the stock is first placed in the lathe and turned to a diameter slightly larger than the finished size

By HOWARD R. HEYDORF



Pencil marking the ball while the lathe is turned by hand. The work is then removed and the ends cut off. A wooden chuck is next made as shown at the right

THE craftsman who wishes to construct tenpins or other bowling games usually encounters difficulties when he attempts to shape the necessary wooden balls. No matter how much care he takes, they usually fail to roll true. The following method, however, will simplify the shaping of any size ball and enables a wood turner of little skill to make a perfect sphere.

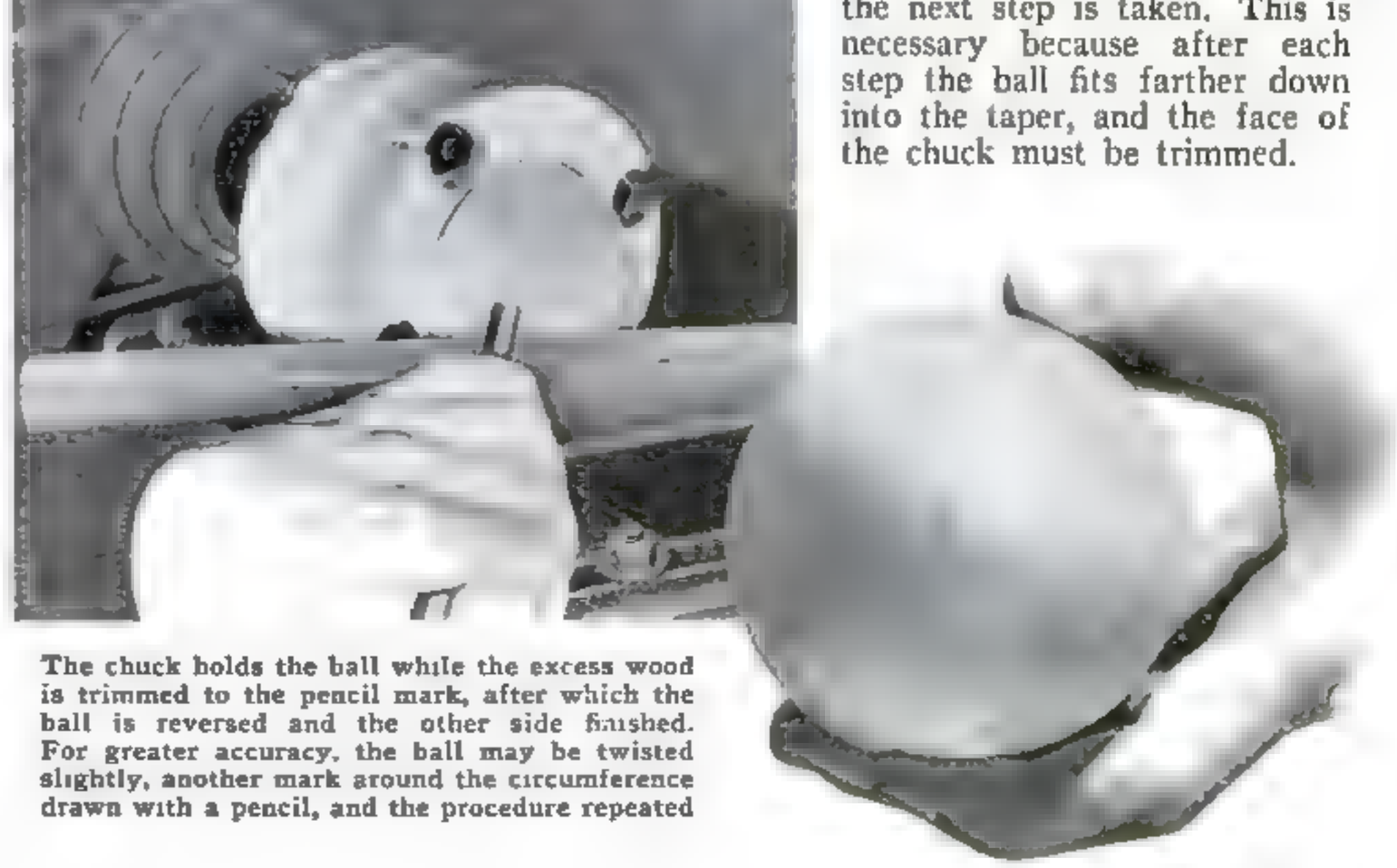
The stock is placed between centers on the lathe and turned to approximate size and shape. A caliper, used to test the ball, should be adjusted to a measurement slightly larger than the finished size. The ball is trimmed until it appears true and the caliper will just slip over it at any angle. A fine cut is then taken off the circumference, which will bring that part to a measurement a trifle larger than the finished size. The lathe is next turned by hand while a pencil is pressed against the ball to make a mark around its circumference. The work is taken from the lathe, and the excess end stock removed. A number of balls may be turned side by side from a single piece of stock.

A wooden chuck is required to hold the ball while it is being finished. Although the chuck is best made from a single block of wood, it may be built up of scrap material, in which case the direction of the grain of each layer should run at right angles to the grain of the piece next to it. The inside of the chuck, instead of being turned to the shape of the ball, is made on a slight taper. This will hold the ball securely and does not require the chuck to be altered after each trimming of the ball. An expansive wood bit set to the size of the bottom of the taper is useful for removing the wood from the chuck center before turning the taper.

The rough ball is placed in the chuck so that the pencil mark around its circumference is in a plane at right angles to the chuck as shown. The wood of the ball is then carefully trimmed to the pencil mark. The work is reversed, and the other side turned. If the work has been done carefully, the ball will be round.

For the most exacting work, the ball may be turned slightly and another mark around the circumference made. The procedure is then repeated. The ball is sanded while still in the chuck. If the work is not too snug in the chuck, the ball's position may be shifted without halting the lathe.

When turning a number of balls, each operation should be made on all of the balls before the next step is taken. This is necessary because after each step the ball fits farther down into the taper, and the face of the chuck must be trimmed.

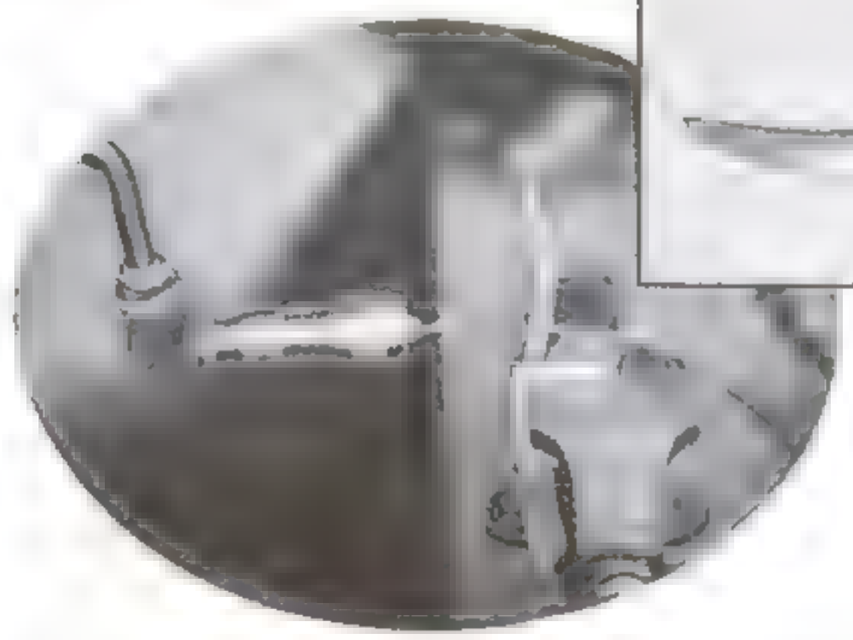


The chuck holds the ball while the excess wood is trimmed to the pencil mark, after which the ball is reversed and the other side finished. For greater accuracy, the ball may be twisted slightly, another mark around the circumference drawn with a pencil, and the procedure repeated

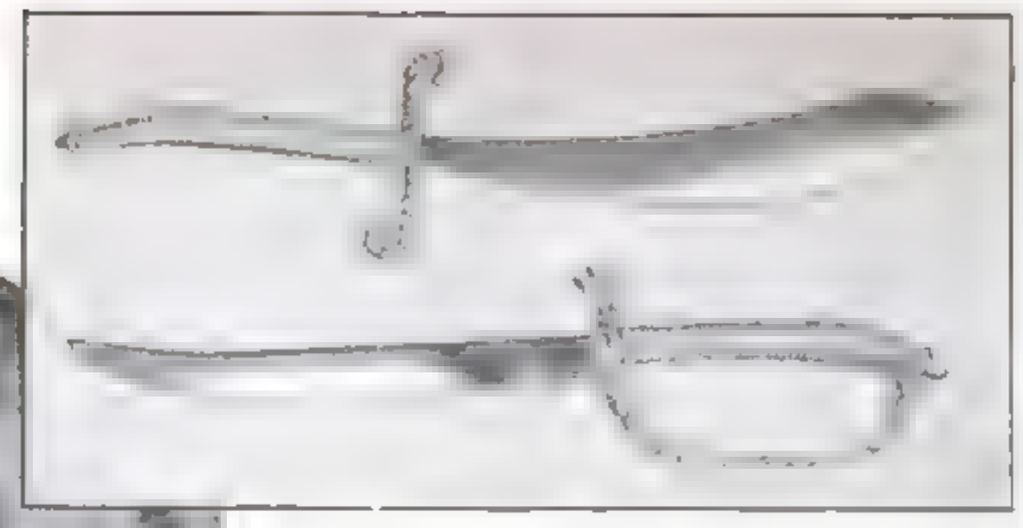
Artistic Paper Knives Cost Little to Make

ARTISTIC and useful letter openers may be made from small pieces of brass or copper and a few feet of wire. Those illustrated were formed from ⅜-in. brass rod, the handles wrapped with 16- or 18-gauge copper wire, and the guards shaped from thicker wire.

The rod is first hammered to the shape of the blade, and the handle is slightly flattened and formed to an oval section. The knife is finished by filing and then removing all file marks with emery cloth. A hole is drilled at one end of the handle to receive the end of the wrapping wire, and the entire handle closely wound.



An auger-bit brace is used to twist the copper wire into a guard. Then the untwisted end is opened, fitted around the handle, and wrapped in a similar way



Both the scimitar and saber types of knives are useful novelties for your desk or table

How a brass rod is hammered and gradually transformed into a decorative letter opener

To make the twisted guard of the scimitar type, two pieces of 12- or 14-gauge copper wire 6 in. long are held in a vise and twisted with an auger-bit brace for half their length. The untwisted end is then opened, fitted around the handle, and twisted in the same manner. Care must be taken to have the wires placed evenly in the brace jaws and to keep a slight tension during the twisting.

The guard of the saber type is made from a piece of wire 12 in. long. Loop the wire around the butt of the handle and place the ends as far into the jaws of the brace as possible. Twist tightly, open the untwisted end, fit it around the forward end of the handle, and complete the twist. Then trim the ends to length and finish

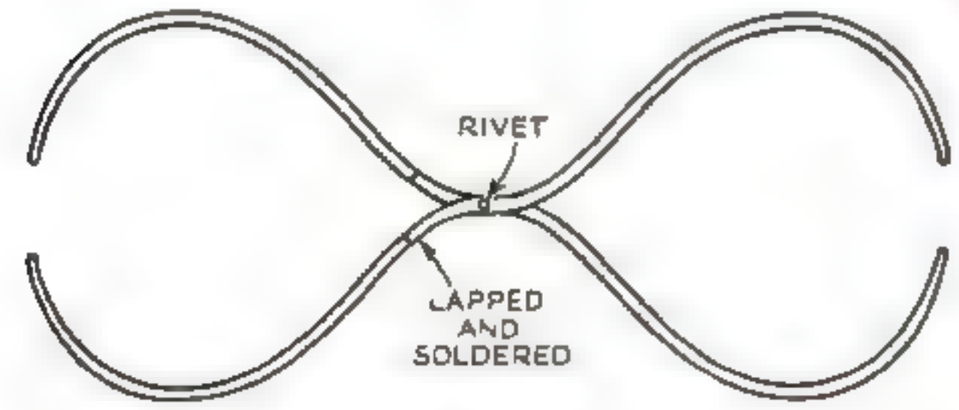
Any looseness in the guard at the point of contact with the handle may be easily overcome by sweating the joint with solder, and it is wise also to solder lightly the end of the twist to prevent the wires from separating when bending the small curl at the ends. Final polishing may be done with powdered pumice, steel wool, metal polish, or a buffing wheel if it is available.

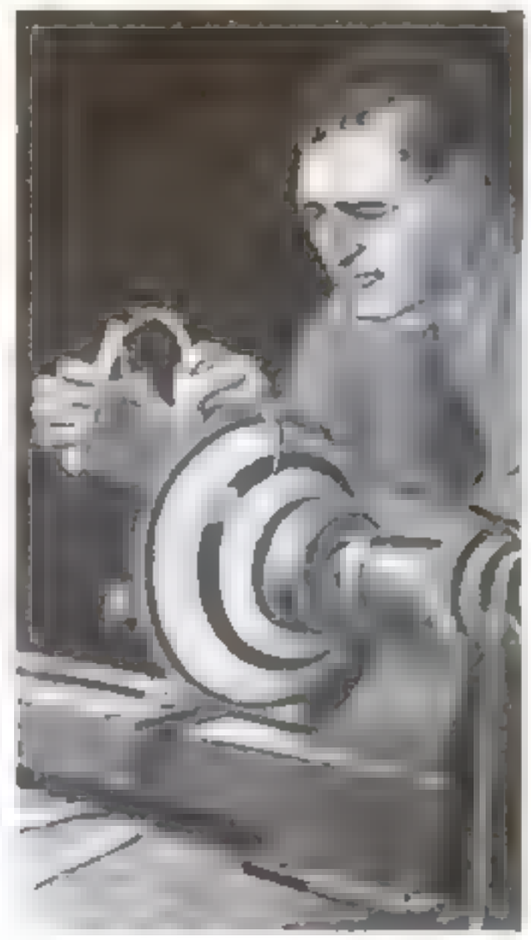
A word of caution may be necessary: hammering or working brass or copper hardens the metal and if carried too far, may cause it to split or crumble. After the metal has been hammered until hard, it may be softened again by annealing. To anneal, heat the metal until uniformly red, and cool by plunging in water or allowing to cool normally. Copper may be forged red hot, just as iron or steel, but brass, being an alloy, may crumble if worked hot.—W. S. KREHBIEL.

TWIN CALIPERS AID IN WOOD TURNING

WHEN turning picture frames, nut bowls, round boxes, and similar work, it is difficult to determine the exact thickness of the wood, especially if there is a rim or flange that prevents ordinary calipers from being used. Transfer calipers can, of course, be obtained for making such measurements, but still more convenient is a double-ended tool made as shown from two ten-cent calipers of the common flat type.

Cut off the arms close to the butt ends, lap the opposite pieces together in pairs, and solder each joint. Then the two reversing arms are riveted in the center. The great advantage of this device is that when one pair of legs have been closed on the work, the exact thickness is made visible by the other pair of legs and can be measured with a scale.—A. E. LANGWORTHY.





By means of the double calipers, you can easily take measurements otherwise difficult to estimate

FILED KEY OPENS DRAWER LOCKS THAT STICK

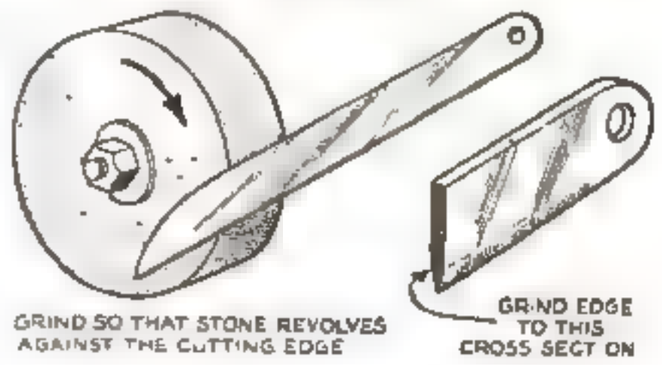
By filing away part of the key, it is often possible to open bureau locks which have their tumblers stuck

IN DAMP weather it sometimes happens that locks on bureaus and dressing-table drawers stick and cannot be opened with the key ordinarily used. This is caused by the swelling of the wood around the lock in such a manner that the tumblers become lodged halfway. To open such a lock, one furniture repairman merely files the key as shown. Two or three turns of the key in the lock will then usually cause the latter to open without difficulty.

HACK-SAW BLADES MADE INTO KITCHEN KNIVES

MOST kitchen knives soon lose their sharpness, but it is possible to make one from a worn-out power hack-saw blade that will open tin cans, joint chickens, chop bones, and still hold an edge keen enough to slice hot bread.

The blade may be obtained for the asking from almost any machine shop, foundry, or large garage. If a file will not cut the back of the saw, the blade will be suitable; it should not have a soft back. Grind off one end so the knife will have an over-all length of 11 in. Taper the end as shown and then grind the cutting edge slowly so that it will not burn. The handle is made by melting shellac flakes in hot water, forming the plastic material around the butt of the blade, and binding it with a layer of cotton tape; then apply two or three coats of shellac dissolved in alcohol.—W. C. CHENEY.



Pocketknife Caricatures

How to whittle amusing faces for use as ornaments or to decorate tie racks, book ends, bottle stoppers, inkstands, paper weights, and other small novelties

By

E. J. TANGERMAN

Five examples of carvings similar to those made in the Italian Tyrol. These heads, which can be whittled very easily, are amusing in themselves and can be used for many purposes

FOR many, many years, Tyrolese peasants have been famous for their whittled toys, but it is only recently that Americans have had an opportunity to see and to enjoy the little grotesque figures and heads that these people whittle. Several examples from the Italian Tyrol are shown in an accompanying photograph. The row of heads along the bottom are "in the round," while the man and woman above are low-relief silhouettes.

Let's take the right-hand man as an example. Whittle or turn on a lathe a rough sphere 1¼ in. in diameter, leaving wood below for a hand grip. The grain should run from the neck to the top of the head. Select a smooth, even-textured part of the blank for the face, and draw crosslines on it, one to represent the middle of the face, the other the line of the eyeballs. Notice particularly that the eyes are halfway between the chin and the top of the head. A quarter inch below the eye line, draw another parallel to it to represent the bottom of the nose.

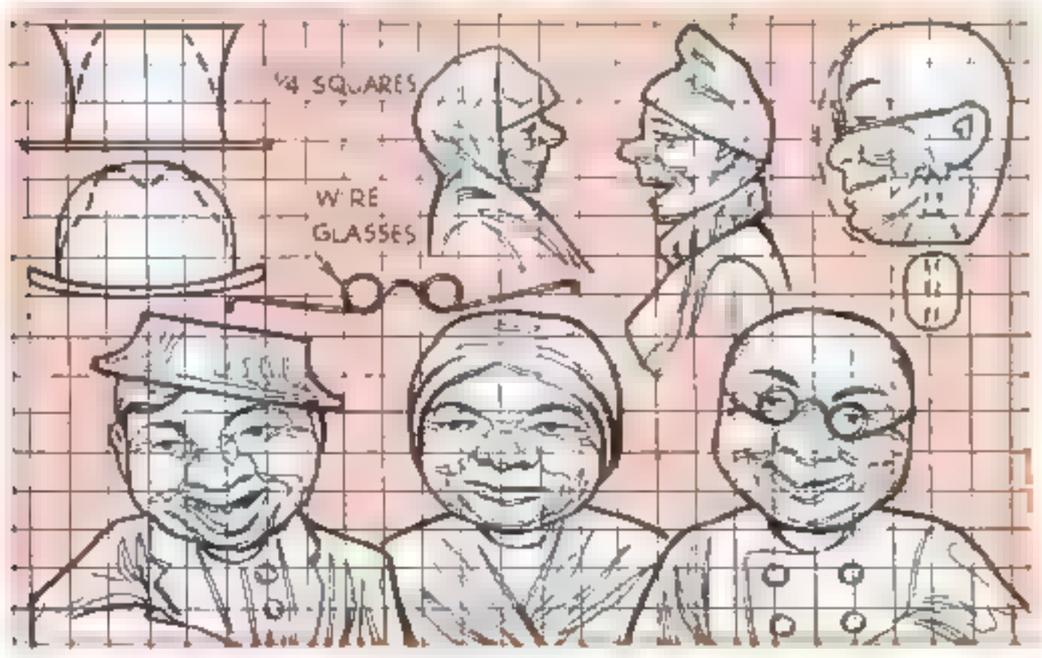
Sharpen your knife, and cut across the line at the base of the nose; then shave away the wood beneath it to form a flattened spot for the mouth until the nose portion projects about ⅛ in. With the knife tip, outline the side of the nose, which is ⅜ in. wide at the nostrils and 3/16 in. wide at the bridge. Cut away 1/16 in. of wood at each side to make the nose stand clear. The blank will now look like the left-hand side of the block in the second photograph.

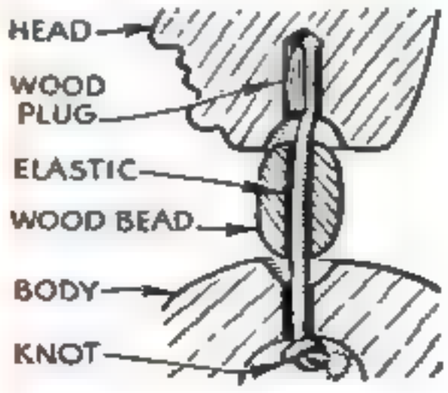
First steps in whittling a face. Note that the stock is left long to give a good grip

Next cut a deep V-groove sloping downward from the bridge of the nose to form the eye socket and to outline the top of the cheek. Notch out a V between nose and cheek to make the nose still more prominent, and cut out a shallow U across the bridge of the nose to accentuate the nose tip.

Now study the photographs and drawings again to get a clear picture of the relationship of nose, cheeks, and mouth. Sketch the mouth position and angles on the blank.

Below the cheek bone, toward the outer edge of the face, a large section is cut away to emphasize the cheek bone and form the line of the jaw. The side view in the drawings shows this portion cut away, so that the lips project from the face proper. From the corner of the nostril, cut a deep outward-curving crescent on each side; then cut down to it from the center line of the face, thus forming a projecting V area below the nose. Sketch in the mouth line again and cut a V all along it, making the mouth a long V-groove in the shape of a V turning upward and backward. Cut out just below the V to form the prominent lower lip and the chin, and shape in the upper lip slightly to the nostril. A little wedge of wood cut out at the nostril will accentuate the size and flatness of the nose.





By means of a wooden bead fitted into a socket hollowed as shown above, the head can be made movable. Tiny plugs lock the elastic which holds the head. Patterns are given at left

Cut away the lower end of the cheek crescent at the side of the mouth and put in a line or two to represent laughter wrinkles or a dimple. Cut in a little U between lower lip and chin, and a long, shallow U just above the cheek bone to represent the eye socket. The blank will now look like the right-hand side of the block in the photograph that shows the operation of cutting notches to emphasize the double chin. Smooth up all lines, put a wrinkle or two at the outer edge of the eyes, and the face is finished.

The ears are simple V's in the shape of question marks with a cut-out dot in the center. They are *(Continued on page 87)*

HOW TO MIX AND APPLY

Shingle Stains

By RALPH G. WARING

It is best to start the job by using a flat stroke, run downward, to cut in next to the window casing. Wrapping paper protects the flower bed. Note at left the safety spikes on the ladder

FOR the many home owners who do most, if not all, of the general upkeep work around their houses, the problem of staining wooden shingle roofs or shingle side walls is comparatively simple. Under average requirements, it is not even necessary to use a special shingle stain. Ordinary house paint, if made by a reputable paint manufacturer and properly thinned, will prove entirely satisfactory, and it has several advantages from the standpoint of the amateur painter.

Much has been written in the past, of course, extolling the merits of shingle stains, and it is true that at least one manufacturer has been able to produce a durable stain of remarkable penetration. Both practical painters and paint technicians have held for many years that the penetration of paints and shingle stains into new woods was both desirable and necessary. New technical data and oils that are now available are modifying this belief. There is strong evidence that future practice will be considerably altered because of the revised theory that adhesion rather than penetration is what is required for the successful maintenance of a painted or stained surface.

One exception to the use of thinned paint on shingles should be noted. Those who live in a warm and humid climate, such as that of the South Atlantic and Gulf States, may find a shingle stain made on a creosote oil base more desirable in order to prevent possible mildewing.

Under all average conditions, you may select whatever color of first quality house paint appeals to you most. For example, a good clear green of nonfading quality can be used for the roof and blinds or shutters, if the house happens to have them. In case there are no blinds, the green can be used on the window casings and sill. For the sash, use a light ivory to increase the amount of light admitted through the windows. For the body or shingled walls of the house, a very light gray may be chosen, such as would be made from the ivory sash paint tinted cautiously with a trace of ivory black in oil.

Cut in at the shingle butts by using a stroke that keeps the tips of the bristles well against the bottom edges of the course above

The home owner who wishes to mix his own colors need buy ivory only. This base can be tinted as just suggested to make the gray; and this in turn can be shaded with a chemically pure (c.p.) grade of medium chrome green in oil to produce a large number of soft gray-greens of the jade green type, which constitute some of the most beautiful greens available. Keep a careful record of what materials you added to each gallon of ivory base you may want to match the color later with another batch. If you do not care to mix your own color, buy the prepared paint of the shade you desire.

Regardless of whether you mix your own or buy a prepared paint, when used on shingles the paint must be thinned about fifty percent. The full-bodied paint would give the shingles a cheap, "painty" effect. For thinning, use an inexpensive turpentine substitute or paint-and-varnish naptha in the ratio of four gallons of the substitute turpentine to one gallon of pure turpentine. The genuine turpentine is added as a definite precaution to keep up the solvency of the composition thinner and prevent any trouble which might occur as a result of a possible reaction between the materials in the paint and the substitute turpentine. The latter is used only to reduce cost, since all the turpentine evaporates from the paint film anyway and therefore is needed merely to enable the stain to be spread easily and to allow the film to dry "flat," or without any gloss. High quality paint reduced in this way will dry properly, leave the fuzz on the shingles intact, display the natural grain of the wood, and will wear about three years before need-

(Continued on page 125)

Good Tool Cabinets

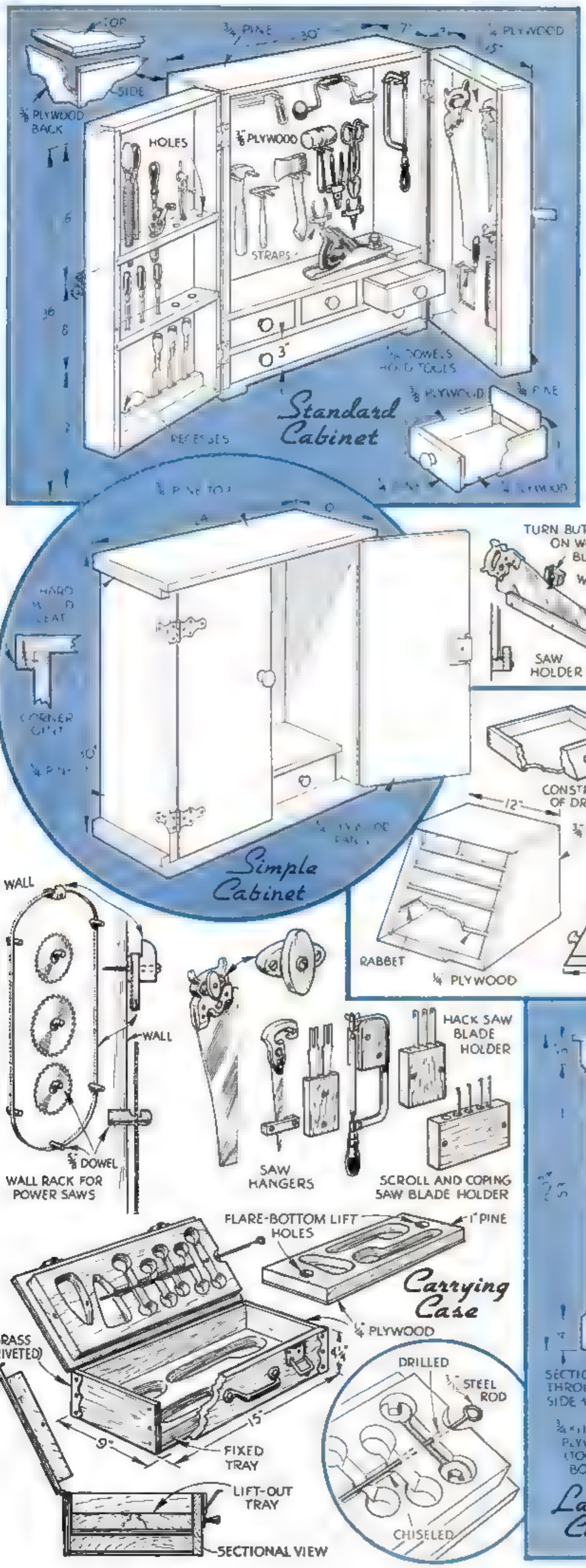
IMPROVE YOUR SHOP

By Hi Sibley

THESE tool cabinets and tool boxes are designed to meet a wide range of needs. In each case individual racks and pegs should be arranged to hold the tools on hand. Sturdy construction is required for the doors and swinging tool panels, and all hinges and angle brackets must be heavy, because there is considerable weight when the tools are in place.

A compact carrying case for small tools, such as end wrenches, dies, drills, and chisels, is illustrated in the lower left-hand view. In the lid, a rod or stiff wire prevents the tools from falling out. The front is of heavier material than the sides so that it will stand the strain when the box is carried by the handle.

If tools are kept in a damp cellar, they should be kept in a cabinet with a snug door. Some mechanics place a pan of kerosene under their handsaws to prevent rust; others use a self-oiling arrangement.



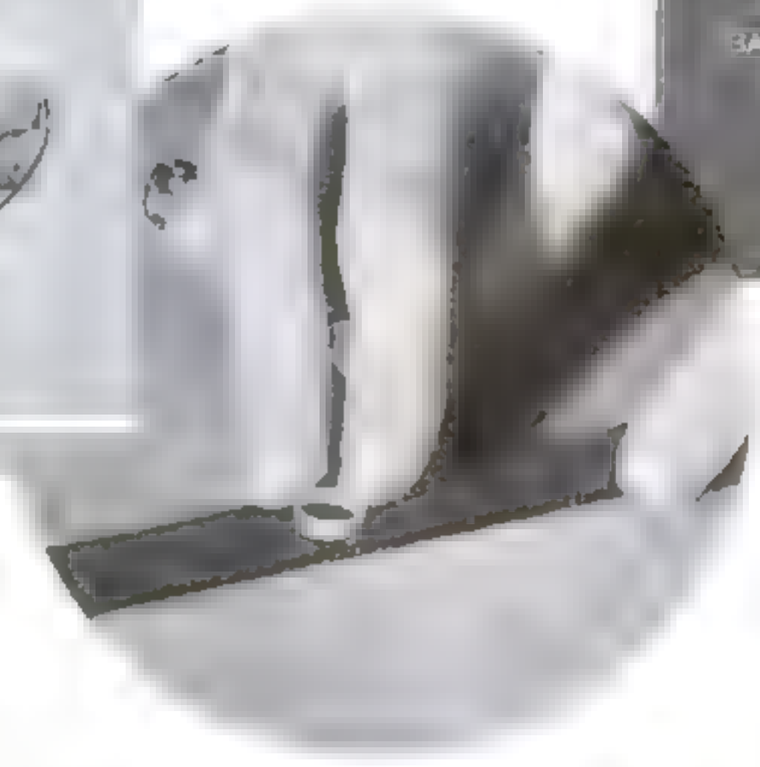
Jewelry Making

Simplified for Beginners

By W. T. Baxter

Six rings and a brooch. Several of the rings represent the first efforts of Edward Bush, 17 years old, who is a pupil of Mr. Baxter

How to make plain and ornamental bezels of two types, with and without a stone support



RINGS, bracelets, and other jewelry are quite easy to make from silver in wire and sheet form. The few tools required include small files, a pair of small, pointed pliers, and an alcohol blowtorch or a blowpipe for use either with gas or an alcohol lamp.

The silver used in a ring costs only a few cents. It may be purchased in two grades, sterling and fine. Sterling is 925/1000 pure, the remaining 75 parts being copper, added to give durability. Fine silver is pure and, being much softer, is easier to work. It is excellent for bezels.

Shaping a finger band on a mandrel. The band in this case is made of wire like the first type shown in the sketches at right. Note bezel and stone in foreground

Few types of craftwork offer a better opportunity for originality and variety in design. Many examples are shown in the accompanying photographs, and the sketches explain the methods of construction. Instead of stones in the rings, various ornaments, such as monograms and souvenir coins, may be used.

Brooches and bracelets are made in the same way as rings. At the top of the facing page is illustrated a bracelet with three large garnets and four other stones, all set with box bezels. In the group of rings shown above is a brooch with four opals; in this case supports are used in the bezels as explained later.

The ring of thunderbird design is made of 20-gauge sterling sheet, and the stone is turquoise. The thunderbird is an Indian symbol meaning "sacred bearer of happiness unlimited." The eye of the bird, an empty circle, is made with a nail set. It represents "life," while the circle with a dot in the center, which appears directly beneath the stone, stands for "spirit." Instead of the stone, other Indian symbols may be used

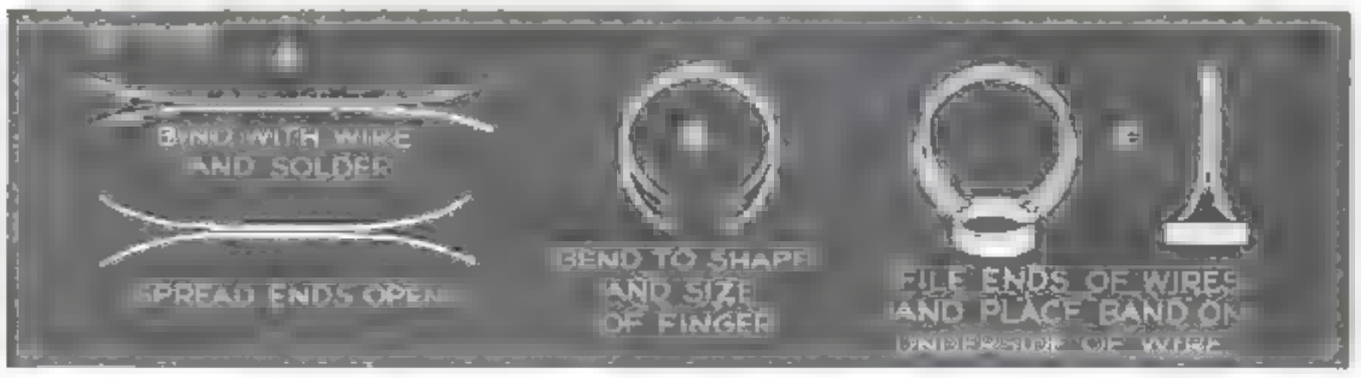
The coiled-serpent ring shown in drawings near the end of the article is modeled after some old Roman designs dating back to the first century A.D. A portion of the wire is bent back against itself and silver soldered; then the head is filed to shape and the decoration applied by using a small chisel or matting tool. The love-knot ring is simply three circles of wire. These are joined together to form a chain and then bent to overlap each other, as shown.

The operations in making the rings are as follows:

Silver soldering. Known also as hard soldering, this type of soldering requires intense heat. The solder melts at from 1,300 to 1,600 deg. Fahrenheit.

Silver solder is an alloy of silver, copper, and zinc, and a small amount may be made by placing two parts of silver and one part of brass upon a charcoal or asbestos block and fusing the two. Because it contains copper and zinc, silver solder will melt before silver does

In silver soldering, minute pieces of solder are used, as all that is necessary is to



The bracelet at the left is made entirely of sheet silver and wire. The ornaments are formed from twisted wire and what is called "shot"—bits of wire melted separately on a charcoal block. The three large stones are garnets

If you live in a small apartment, you may be one of the many readers who have asked us to suggest some form of inexpensive craftwork that requires no more working space than the kitchen table, needs few tools, and is comparatively noiseless. Jewelry work answers these requirements and is not hard to learn.

Three bracelets and a scarf pin. The bracelets are of No. 12 sterling wire. A piece 7¾ in. long is sufficient to form one of them. The pin is of twisted wire with a carnelian, and the ornaments are carved "shot"

fill in between the pieces to be joined. It is essential that the joints be snug fitting, because the solder will not bridge a gap.

For a flux, dissolve borax in water to make a creamy paste. It is desirable to use what is called "borum junk," but plain powdered borax will serve. With a small brush, paint this paste on the joint to be soldered to prevent oxidation. Take one of the tiny pieces of solder, using tweezers or a brush, dip it into the borax solution, and place it on the joint.

Use a blowpipe or torch to heat the joint gently until all water has evaporated from the borax. Then apply more heat until the metal is red-hot. Silver solder will run in the direction of the hottest part, and for that reason it is advisable to keep the flame on or around the joint after the piece is red-hot. Be cautious, however, to build up the heat gradually, for if the flame is applied to the joint at first and kept in the one place, there is danger of melting the wire.

Another thing to bear in mind is to keep the flame off the solder as much as possible, for the piece of solder, being small, will melt quickly and ball up; and if flame is kept on it in this condition, the zinc, being volatile, will vaporize and burn, and then the solder will not readily flow. It will flow when the entire piece is at the correct heat. Keep up a gradual movement of the flame to avoid overheating and burning in any one place.

In soldering small pieces, such as leaves, make a few filings from a piece of silver solder. Mix these with a little powdered borax and apply a tiny amount to the joint. At the instant the filings melt, push the leaf ornament against the piece to which it is being soldered.

To keep a joint from opening up when soldering another joint close to it, paint it over with borax cream, or use a paste made up of yellow ocher and water, or jeweler's rouge and water.

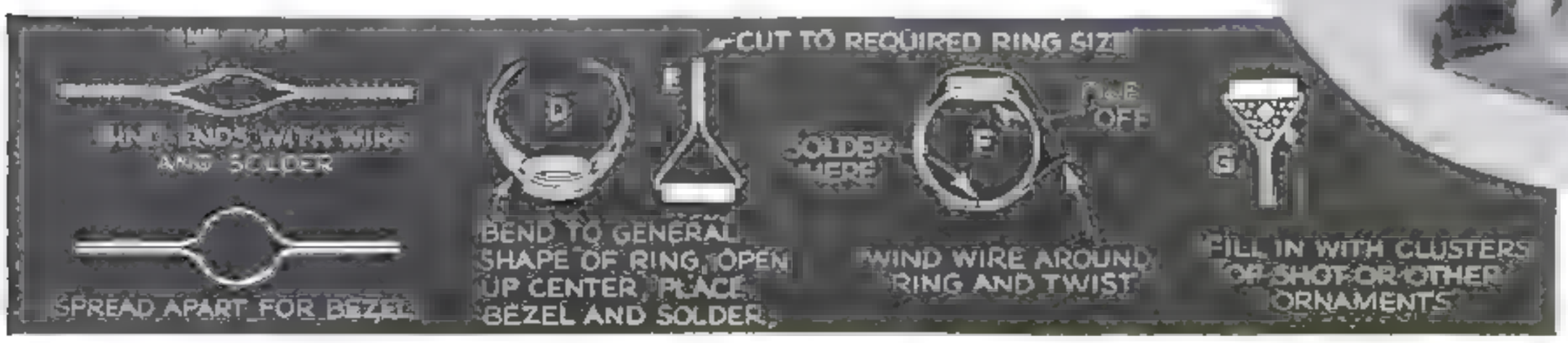
Bezel. Before starting to make the bezel, study the stone to be mounted and decide what type is desired for the ring you are making. In most instances, the bezel with a support inside will be used. By carefully fitting a piece of paper around the stone, the length of the piece of silver may be found. Make the bezel a little higher than required; then file it down to the required height on a smooth file.

The bezel may be made from a piece of 26-gauge sterling or fine silver, or if neither of these is available, two or more small silver wires may be twisted together and then hammered flat on a smooth surface.

Shape the bezel to fit the stone, remove the stone, bind with small black binding wire, and solder the joint. Do not use copper or bright wire for binding because the solder will stick. *(Continued on page 106)*

Cutting veins in leaf ornaments with tool made from a nail set. The silver is resting on solder. *At right:* Various designs

Applying a bit of silver solder on end of brush to joint between bezel and finger band. Bands are made as shown at the left



Universal Clamping Jig

FOR SHIP-MODEL HULLS

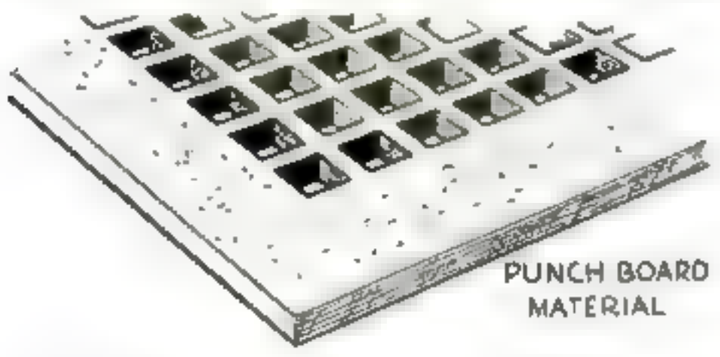
How the jig is used to glue the deck on the hull of a galleon model. It is equally useful for gluing up the "lifts" or layers of an ordinary "bread-and-butter" hull

IN CONSTRUCTING ship models from POPULAR SCIENCE MONTHLY plans, I have developed several kinks, the most useful being a method of clamping the hulls for gluing the "lifts" or layers together and for carving, drilling, and the like. Good carriage clamps or cabinetmakers' hand screws cost money, and even if one has a number of them, there are times when it is exceedingly difficult to hold the work and simultaneously apply the clamps, unless one is blessed with three hands or an amiable wife. Not having three hands and being desirous of keeping peace in the family, I built the special device illustrated.

It consists of a heavy piece of oak 8 by 24 by 1⅞ in.; six heavy cup hooks; six small turnbuckles; three ¼-in. steel rods 10 in. long, and several wooden wedges. On one face of the board, centered lengthwise, a groove ⅜ in. wide and ¼ in. deep is cut; and on each of the two long edges, three heavy cup hooks are inserted. The groove forms a recess for the keel of the model and serves as a guide in aligning lifts when gluing them.

Although the use of swab sticks or applicators in building ship models has been mentioned incidentally in various articles, the idea deserves to be emphasized. These small sticks, universally used by doctors and dentists, can be obtained at any drug store. They are excellent for constructing rail stanchions; for half-round moldings on the hull, one side being sandpapered down; for flagstaffs, oars, and similar items.

A weak point in many ship models is the marking of the deck planks. Many an otherwise fine model has been marred because its builder has ruled off marks to simulate deck planks which, if enlarged to full size, would be 4 or 5 ft. wide. Keeping as near to scale as possible, I rule my deck planks with a hard pencil, applying just enough pressure to indent the wood slightly. Then I lightly sandpaper the surface and apply a light coat of varnish. The indented pencil lines show faintly through the varnish.—F. M. MEALS.



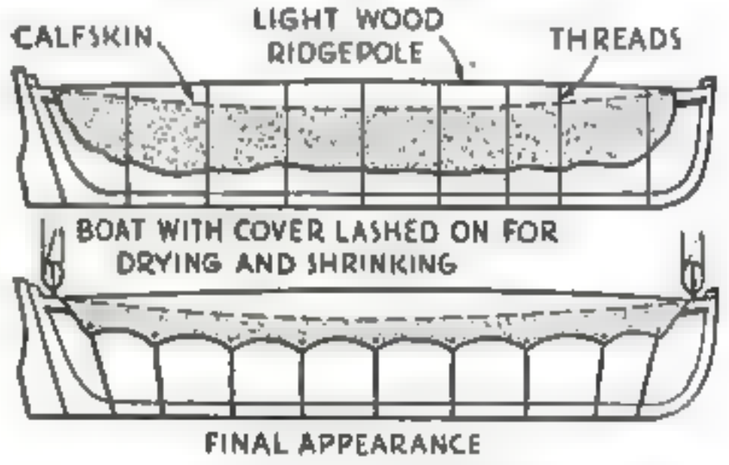
Old Punch Board Makes Ship-Model Gratings

A SQUARE-HOLED punch-board game provides good material for ship-model gratings. The board is of perforated cardboard, which can be split into layers of whatever thickness is necessary, and cut to size with a sharp razor blade. By carefully filling the holes with transparent cement from the bottom, the effect of glass may be obtained. Set the grating in suitable framework.—H. E. HANKEY.

Realistic Lifeboat Covers Cut from Calfskin

REALISTIC covers for the lifeboats on model steamships may be made from sheepskin or calfskin of the kind used for the heads of drums or banjos. The broken heads can be obtained for next to nothing at any music store where instruments are repaired.

Cut the pieces to the correct length and a little wider than the boat to be covered. Soak them in warm water until soft and pliable, wipe dry with a cloth, and hold in position on the boat by wrapping with thread. Place on the back of a stove or on a radiator overnight to harden and dry. Then cut the covers to the proper shape with a sharp knife or small scissors. Burn the holes with a hot needle or wire of the right size and sew in the cords that hold the covers in place. No paint or finish is needed as the color is a perfect imitation of canvas.



After the cover has been shrunk, the edges are cut to imitate very tightly pulled canvas

The material is also excellent for imitating the canvas used as a windbreak on a steamer's bridge rails.—OTIS WOOD.

Tiny Turnbuckles for Model Use

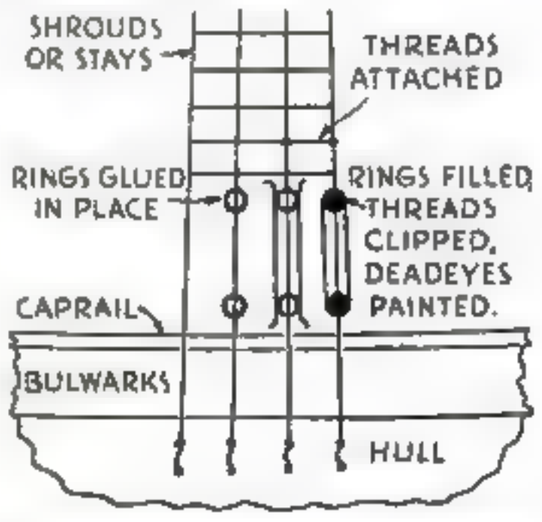
Enlarged view of brass form

TO MAKE miniature turnbuckles in quantity, take a piece of sheet brass about 1/16 in. thick and cut it to a width equal to the length of the desired turnbuckle; then file *E* as shown and round *C* and *D*. Hammer some small copper wire slightly to flatten it and wind it in and out through the slits. Remove the bent form, cut off the excess wire, hammer both end loops flat the other way, and apply a drop of solder.—J. H. DODGE, JR.

Wire Rings Serve as Very Small Deadeyes

WHILE constructing a very small model of a trawler, a firm specializing in marine models was confronted with the problem of making deadeyes about 1/16 in. in diameter, and the following method was found to be satisfactory:

Rig up the masts and run shrouds and stays as if not using deadeyes; glue or cement two small rings of the desired diameter to the shroud or stay, outboard; glue or cement a thread to the outside of each ring; cut away the shroud or stay between the rings, being careful not to cut the two outside threads (or leave it in place for extra strength, if desired); add a center thread to the deadeye if the shroud has been cut; fill the center of each ring with cement or glue; and paint the deadeyes black.



The three steps required to make the wire rings into neat deadeyes

FOR BLUEPRINTS OF TESTED SHOP PROJECTS, TURN TO PAGE 88.

HOW TO ETCH

Half-Tone Engravings

By KENNETH MURRAY

Above: **Soaking the inked plate in water; then all but the dots of the half tone are brushed away.** ***At right:*** **Making the tub of plywood for etching**

IN MAKING your own half-tone screen as described last month (P.S.M., Sept. '36, p. 76), you have carried out practically the same operations required for printing an actual half-tone negative on a sheet of zinc; therefore this part of the work will be quite easy.

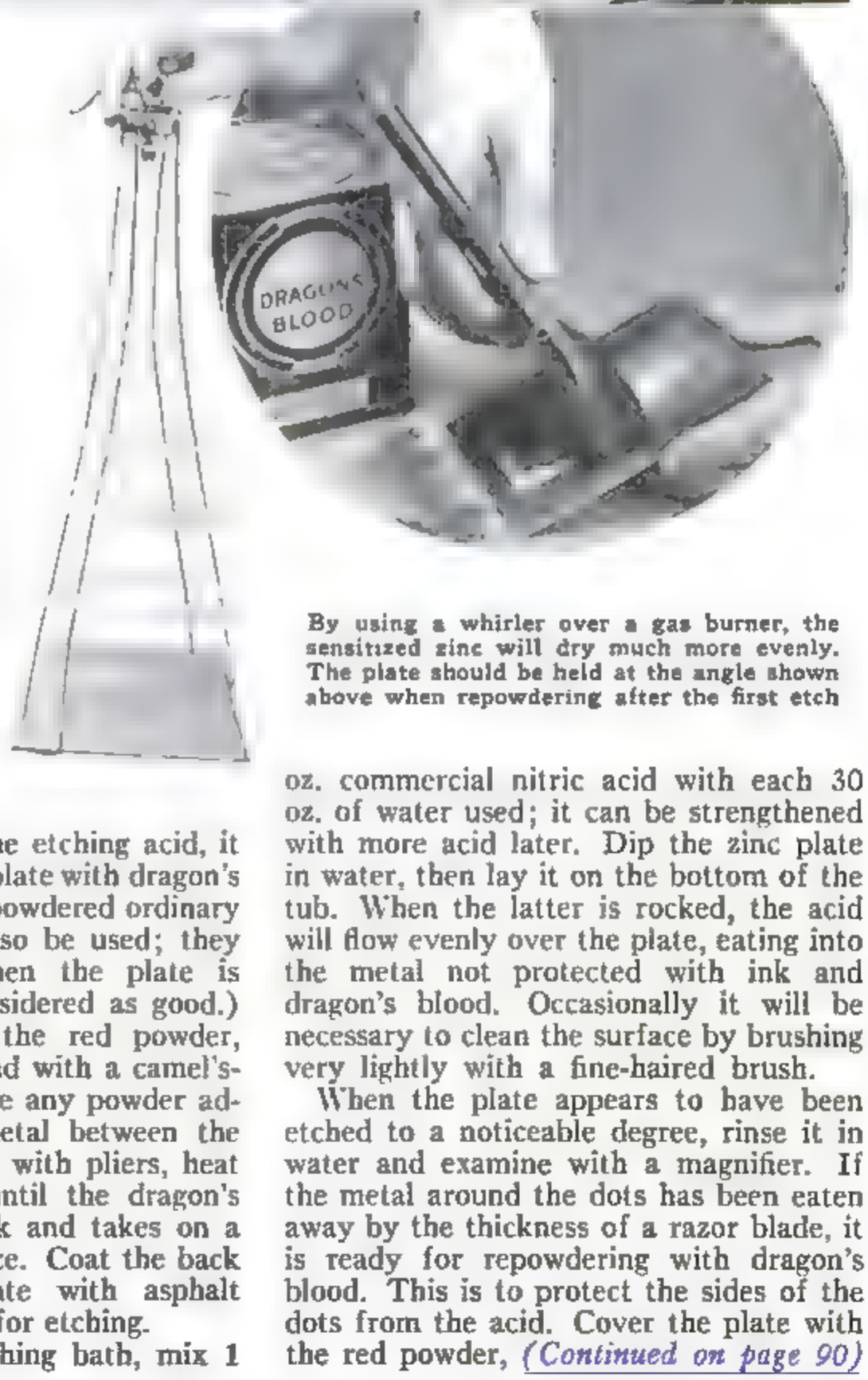
First you will need an acid-proof tub or tray for etching the zinc. While an ordinary developing tray could be used, it would not be very efficient. A tub such as the one illustrated can be made of plywood very cheaply. It is 3 by 14 by 33 in., and the ends are boxed in to prevent splashing the acid. All joints are put together with waterproof casein glue, and it is finally given several coats of asphalt varnish, especially on the inside. Nail a wood rib across the bottom so it can be rocked. Hand rocking of the tub is satisfactory when only a few half tones are to be etched, although if desired a power drive may be added later on as shown in a photograph near the end of this article.

Sensitizing the zinc plate. After cutting a sheet of engravers' 16-gauge zinc to a slightly larger size than the half tone calls for, polish it well with pumice and water applied with a piece of felt. Rinse well and cover with albumen sensitizer prepared according to the directions given in the preceding issue. Drain this off several times to remove all of the water. The sensitizing must be done without allowing air bubbles to form, and care should be taken to see that there are no specks of dust.

The sensitized zinc will dry more evenly if it is slowly whirled over a gas burner. The whirler shown is made of two lengths of heavy wire with the ends soldered to a roller-skate wheel. The movement of one finger will keep the wheel revolving. The whirler should not be revolved fast because this would result in a very thin coat of albumen. When placing the zinc under the negative, be careful not to scratch the sensitive surface; also see that they are both of room temperature, to prevent sweating which would result in sticking. If the exposure is incorrect, take particular pains to remove all of the old albumen with pumice.

Exposing the zinc plate. This is done as described in detail last month. The plate is then "inked up" in the same way as the glass checkerboard screen, except that in this case what is known as "etching ink" must be used. The coat should not be so heavy that you cannot faintly see the zinc through it. Then develop the inked plate with water as you did the glass screen, and dry with an electric fan. In developing, do not rub so hard with the tuft of cotton that the ink will be smeared. If the plate does not develop easily, it was overexposed.

Protecting the plate. To prevent the fine dots from being corroded or undercut by the etching acid, it is necessary to treat the plate with dragon's blood powder. (Finely powdered ordinary rosin or asphalt may also be used; they melt more quickly when the plate is heated, but are not considered as good.) Cover the plate with the red powder, shake off the surplus, and with a camel's-hair brush gently remove any powder adhering to the bright metal between the dots. Holding the plate with pliers, heat it ove a gas burner until the dragon's blood melts into the ink and takes on a slightly glossy appearance. Coat the back and edges of the plate with asphalt varnish, and it is ready for etching.



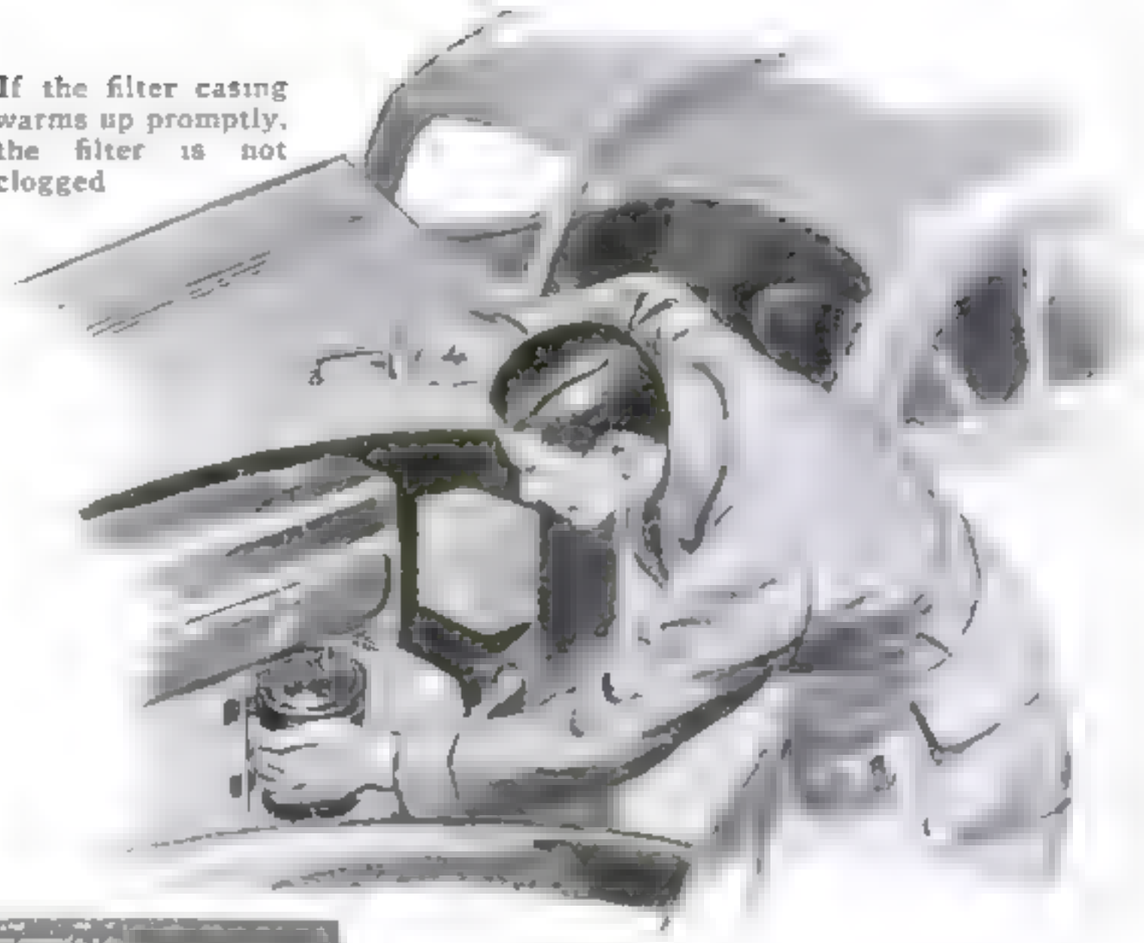
By using a whirler over a gas burner, the sensitized zinc will dry much more evenly. The plate should be held at the angle shown above when repowdering after the first etch

Etching. For the etching bath, mix 1 oz. commercial nitric acid with each 30 oz. of water used; it can be strengthened with more acid later. Dip the zinc plate in water, then lay it on the bottom of the tub. When the latter is rocked, the acid will flow evenly over the plate, eating into the metal not protected with ink and dragon's blood. Occasionally it will be necessary to clean the surface by brushing very lightly with a fine-haired brush.

When the plate appears to have been etched to a noticeable degree, rinse it in water and examine with a magnifier. If the metal around the dots has been eaten away by the thickness of a razor blade, it is ready for repowdering with dragon's blood. This is to protect the sides of the dots from the acid. Cover the plate with the red powder, *(Continued on page 90)*

Six Kinks *for* Car Owners

One of These Timely Suggestions, Contributed by Other Readers, May Help You To Solve a Vexing Problem In Driving or Caring for Your Auto

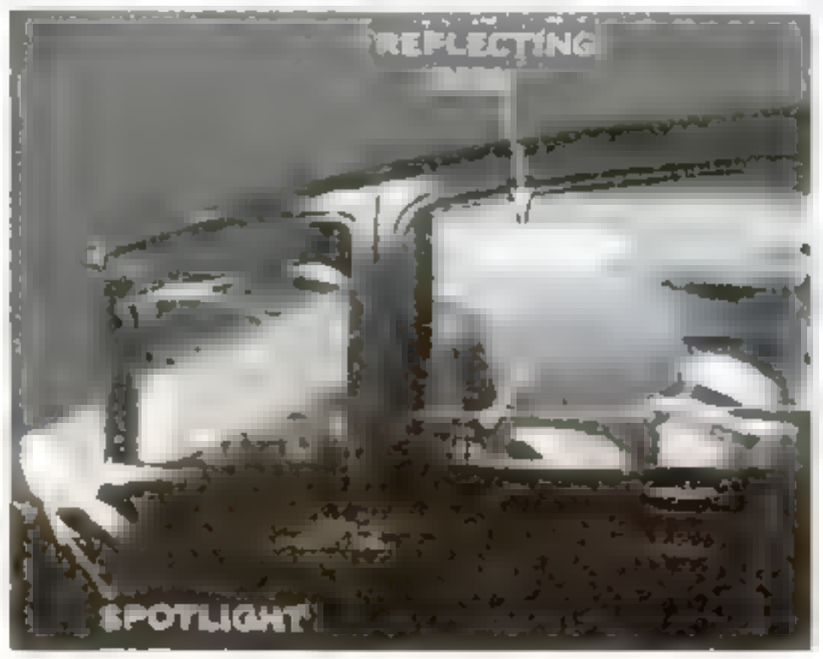


If the filter casing warms up promptly, the filter is not clogged

BECAUSE its inner workings are completely concealed inside a metal cylinder, it is difficult to tell whether a car's oil filter is too badly clogged to operate properly. However, a simple test that will give some idea of its condition can be made by feeling the filter casing after the motor has been run for several minutes to insure a steady flow of oil. If the filter is warm, it is working properly; if not, the probability is that it is partly clogged and a trip to the service station would be advisable. This test should be made shortly after starting the motor and before the engine heat has warmed the filter.—W. C. J

Reflector Gives Light for Reading

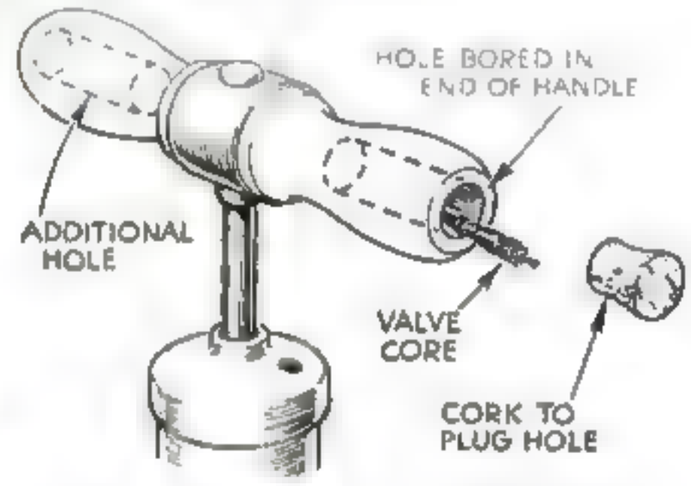
FOR READING, making repairs, or studying a map at night the usual car dome light affords poor illumination. To overcome this, I cut a fifteen-inch metal disk from the bottom of a five-gallon oil can, painted it white, drilled a hole in its center and mounted it over the center of the front seat with a screw driven into one of the wooden bows in the car top. When I need light, I simply turn the car spotlight so its beam comes through the windshield, strikes the disk, and is reflected downward.—K. F. K.



A metal disk fastened to the ceiling of the car reflects a beam of light thrown by outside spotlight

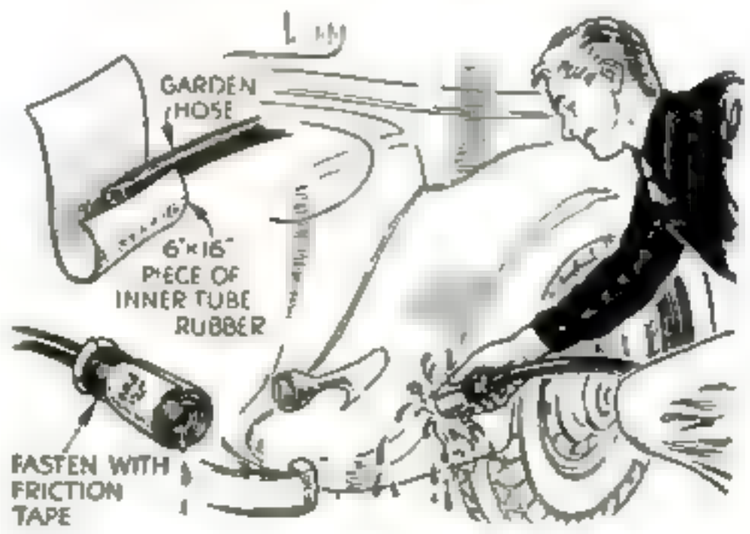
Holes in Pump Handle Hold Valve Parts

BY DRILLING small holes in each end of your tire-pump handle, you can provide yourself with a handy storage place for spare tire-valve cores. The holes, drilled about a half inch deeper than the overall length of the valve cores, can be plugged with small corks as shown in the illustration below.—E. J. N.



Rubber Hose Nozzle Aids in Car Washing

CAKED mud can be removed from a car body and fenders without danger to the finish by using the easy method illustrated. Cut a sheet of rubber about six inches wide and sixteen inches long from an old inner tube and, after removing the nozzle from your garden hose, wrap the rubber strip around the hose so that it overlaps the end about three inches. Fasten it with a strip of friction tape. With a small amount of water running through it, the rubber coil will take off the mud easily.—A. H. W

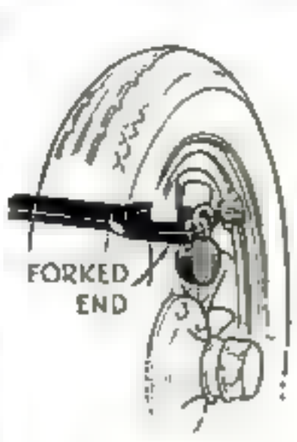


Tube rubber rolled around hose removes mud

Metal Bumper Shields Protect Car Finish

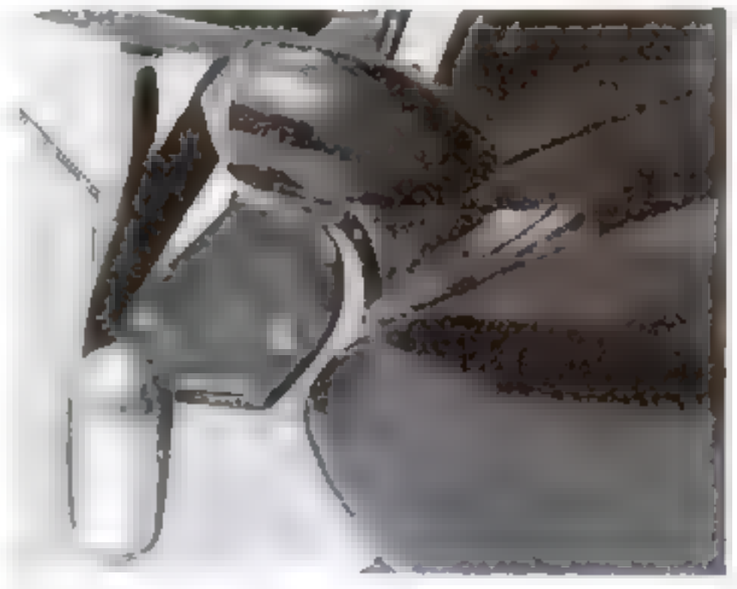
TO PROTECT the rear body surfaces and fenders on my new car from pebbles thrown up by the rear wheels, I have installed sheet-metal shields under each end of the bumper. These shields, made of the same weight metal as the fenders and painted to match, deflect any sticks or stones to the road.—C. B. P.

Long Iron Bar Locks Trailer's Wheels



Trailer wheels are locked securely by this simple device. The drawing shows how it is adapted for spoke wheels

FROM a long iron bar and two heavy padlocks you can make an effective lock for a trailer. Passed between the body and the springs, through the wheels, and padlocked at each end, the bar will make it impossible to move the trailer more than a few inches. If the trailer has solid disk wheels, a narrow slot can be cut through each wheel to receive the bar. For spoke wheels, a forked bar, similar to that shown in the drawing, can be used.—H. S.



Shield attached to bumper deflects pebbles

"NEWS COMES FIRST," says Miss Helen Nolan, reporter, "eating, second. So I turn to Camels. Food tastes better and digests easier."

HUMAN COMETS. Hugo and Mario Zacchini disappear into a monster cannon. *A flash!—a crash!*—and they hurtle into distant nets. "Mario and I both smoke Camels," says Hugo. "Camels keep digestion working smoothly"

FIRST in the gruelling Albany-New York Outboard Marathon! Clayton Bishop says: "Camels are a swell aid to digestion."

PEOPLE CAN MEET TERRIFIC STRAIN—YET ENJOY GOOD DIGESTION.

SMOKERS SPEAK FROM EXPERIENCE WHEN THEY SAY—

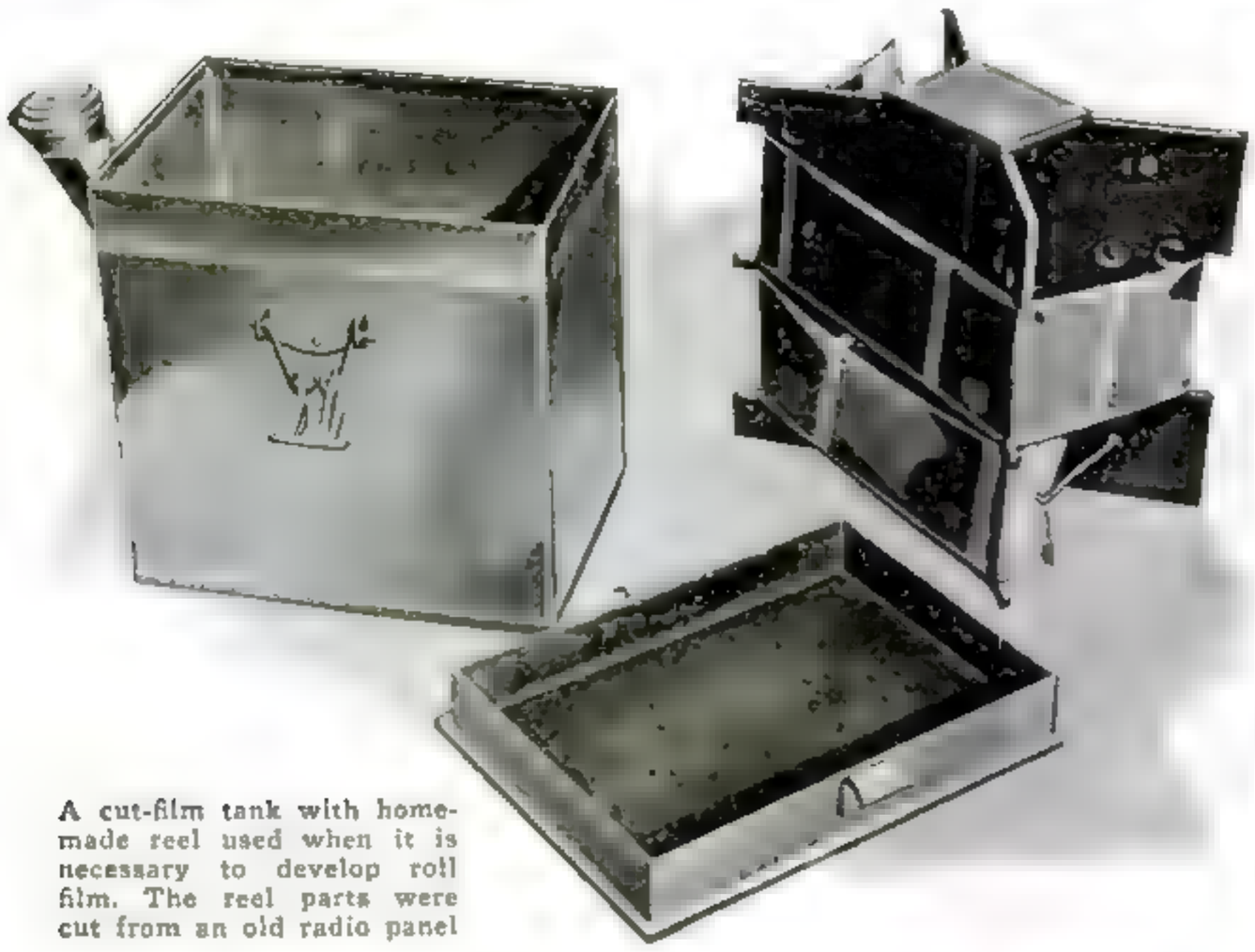
"For Digestion's Sake — Smoke Camels!"

MODERN life bombards us all with a thousand and one little jars, shocks, and nervous irritations. The strain tells on digestion...slows down the flow of digestive fluids.

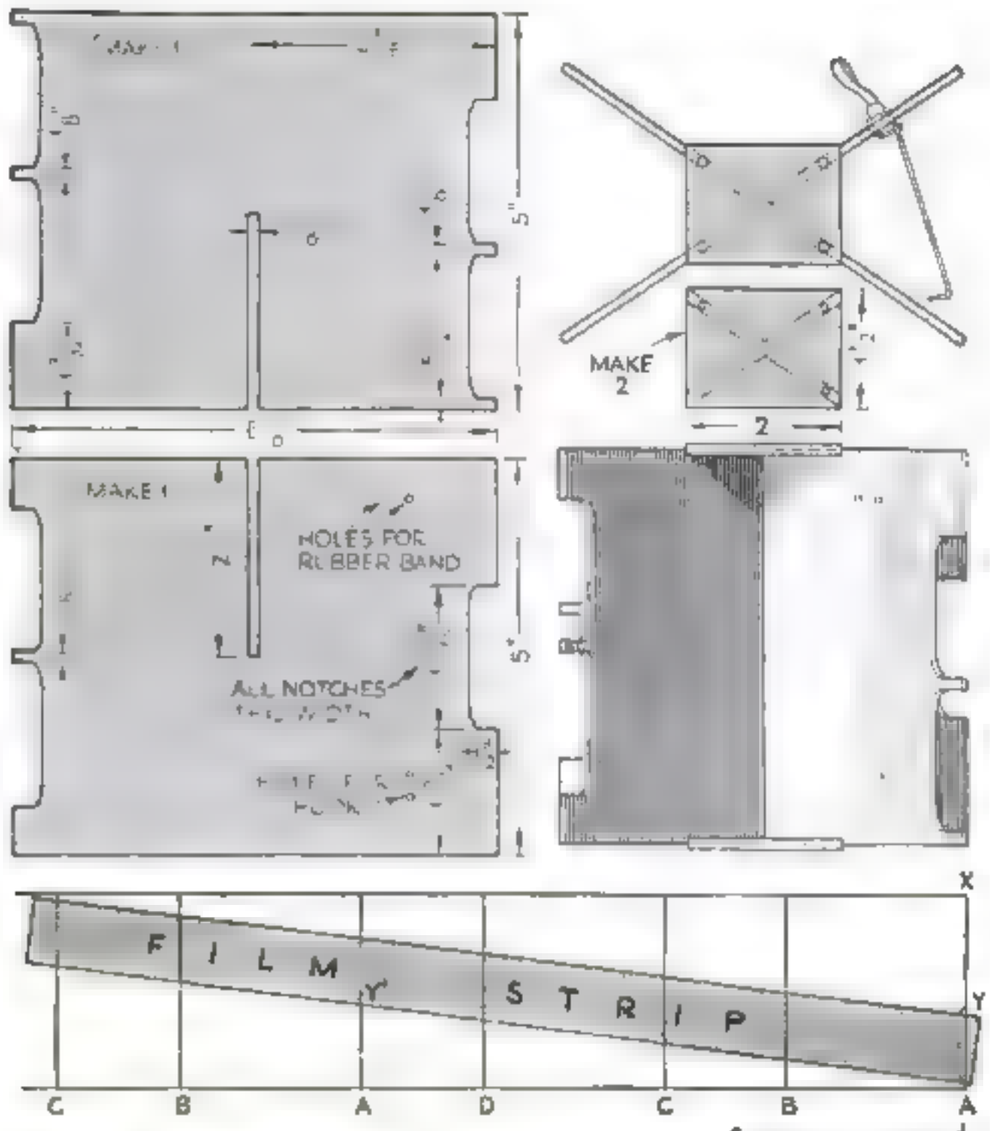
And it is to Camels that one naturally turns to put more enjoyment into eating. As you enjoy your Camels at mealtime, the flow of digestive fluids speeds up...alkalinity is increased. You feel at rights with the world!

Camel's invigorating "lift"...Camel's aid to digestion...Camel's matchless taste and fragrance—all these are yours when you make Camels *your* cigarette. Camels set you right! And they never get on your nerves.

REEL ADAPTS CUT-FILM TANK FOR DEVELOPING ROLL FILMS



A cut-film tank with home-made reel used when it is necessary to develop roll film. The reel parts were cut from an old radio panel



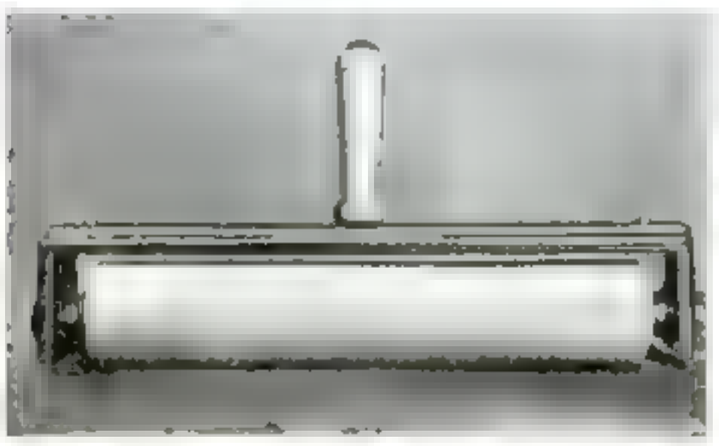
A reel for vest-pocket film and diagram for figuring other sizes: ab=inside length of tank; bc=inside width; AX=inside height; AB=ab minus 9/16 in.; BC=bc minus 9/16; AY=angular film width plus 9/32; AY¹=AY

MANY amateur photographers have both cut-film and roll-film cameras, but hesitate to get a developing tank for each because of the cost. To make one tank do the work, the author devised an adapter to develop vest-pocket roll film in a cut-film tank measuring 3⅝ by 5⅛ by 5¼ in. deep. Larger films could be developed in a proportionately larger tank. The accompanying diagram shows the method to follow for other sizes of film and tanks.

The cost was only a few cents as the main parts were made from a discarded composition radio panel ⅛ in. thick, two nickeled safety pins, a rubber band, and eight small screws.

A pattern of the reel is first cut out of heavy cardboard and glued together with strips of paper to the shape and size of the tank. A strip of film or protecting paper of equal length is fastened in the notches to determine if the notches are correctly staggered. If the film lies in the notches without buckling, it is safe to use the patterns for the actual layout on the composition panel.

The main frames are cut out, and all corners and edges rounded with a file to prevent scratching the film. Next, the end braces are cut and grooved in an X-shape with a hack saw. These are then fastened to the main frames with eight machine screws about ¼ *(Continued on page 96)*



WRINGER ROLLER MAKES HIGH-GRADE SQUEEGEE

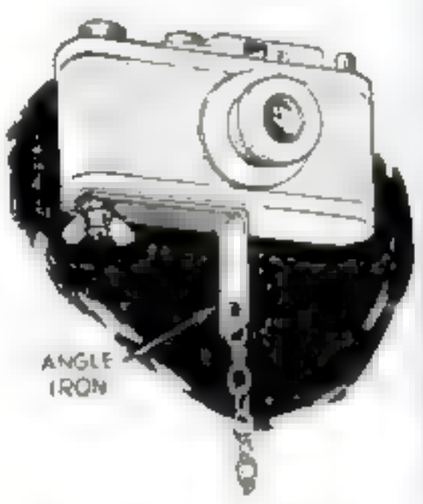
HIGH-GRADE squeegee rollers for photographic use are expensive, but an excellent substitute can be constructed as shown above. For this purpose I obtained a washing machine wringer roller and two ball bearings for seventy-five cents. The roller is the soft type, 2¼ in. in diameter and 12 in. long. The frame is made from sheet iron, cut, folded, and reënforced with a piece of strap iron across the top. The bearing housings are brazed to the frame, and the handle is bolted on.—R. S. WERNER.

ESTIMATING EXPOSURE TIME

WHEN you are using a camera with a ground-glass back, a reliable method of determining the exposure time is to reduce the "stop" opening until the image can just be seen clearly. One second will be a normal exposure for this setting, and other diaphragm openings can be figured in proportion.—E. V. B.

CHAIN "TRIPOD" KEEPS CAMERA STEADY

NEEDLE-SHARP snapshots instead of blurred pictures may be made at exposures up to one-half second by providing a miniature camera with a simple chain "tripod" such as is often used by professional news photographers. Lenses of slower speed may also be made to compete comparably with superspeed lenses. By giving 1/10 second with an F/6.3 lens, for instance, you get an exposure equal to 1/20 second at F/4.5. A quarter second at F/4.5 will give you as fully exposed negatives as 1/20 second with an expensive F/2 lens.



Method of fastening the chain to a small camera

The materials needed are 2 yd. of sash chain or other light chain, preferably with flat links; an iron angle, a few inches of wire, a short bolt to fit the tripod socket on the camera, and a wing nut or two ordinary nuts for the bolt. Select an angle of a length that will bring the vertical part near the center of the camera. The chain is attached with a link of wire.

To use the device, merely adjust the camera to the eye, step on the chain, and hold the chain taut by a steady upward pull on the camera. By bracing the elbows at the sides, the camera is rigidly supported.—K. M. S.

Exposures up to half a second may be made without blurring if the camera is supported in this way by stepping on the chain and pulling steadily upwards

Snapshots this size

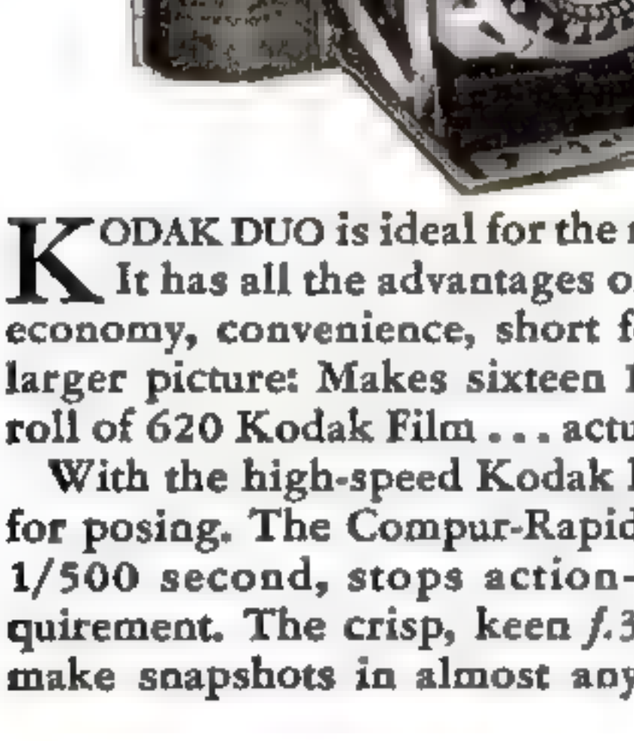
with this miniature camera

Kodak Duo

a true miniature camera
yet it takes a larger picture

KODAK DUO is ideal for the miniature camera enthusiast. It has all the advantages of a small, pocket camera . . . : economy, convenience, short focal length—yet it yields a larger picture: Makes sixteen 1⅝ x 2¼-inch pictures on a roll of 620 Kodak Film . . . actual picture size above.

With the high-speed Kodak Duo Six-20, there's no need for posing. The Compur-Rapid shutter, with speeds up to 1/500 second, stops action—covers any exposure requirement. The crisp, keen *f*.3.5 anastigmat lens lets you make snapshots in almost any light—even at night, with Kodak "SS" Film and Mazda Photoflood bulbs. Complete with depth-of-focus scale . . . optical finder—price $57.50. At your dealer's.



KODAK MINIATURE ENLARGER, MODEL B
Ideal supplement for the Duo. Makes enlargements from Duo negatives up to 16 x 21 inches. Paper cabinet base optional. Enlarger, Kodak Anastigmat *f*.4.5 lens, masking paper holder, iris diaphragm, magnification scale, exposure calculator, $82.50. Without diaphragm, $67.50. Paper cabinet base, $10.

CHOOSE THE RIGHT FILM *Kodak Verichrome Film* is an excellent all-around picture maker. Has great latitude, guards you against exposure errors . . . *Kodak Panatomic*, extremely fine-grained, designed especially for miniature cameras. Makes striking enlargements . . . *Kodak "SS" Panchromatic*—extra speed for difficult pictures. Completely color-sensitive. Ideal for snapshots at night with Mazda Photoflood bulbs.

FREE a booklet you'll want in your photo library

Gives complete information about miniature Kodaks and enlargers. Write today . . . Eastman Kodak Company, Rochester, N.Y.

Name_____

Address_____

City_____ State_____

PS-10-36

Model of the *Great Republic*, famous clipper ship. A duplicate of this can be built from the materials in our construction kit 4S

Our Construction Kits

Make It Easier to Build Models

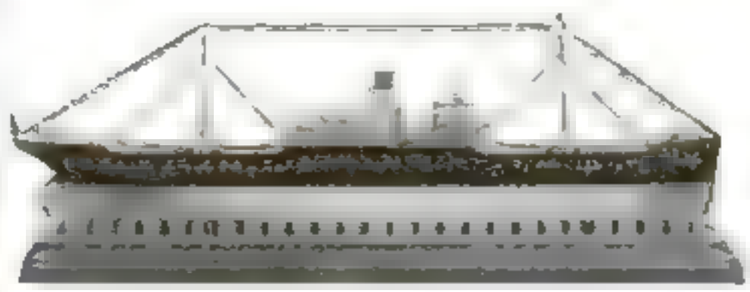
BUILDING a ship model is much easier if you have the right materials with which to work. It is difficult, however, to obtain many of the small odds and ends that are required. For this reason we have prepared construction kits containing everything in the way of raw materials needed to construct a variety of accurate and beautiful models.

Many types of vessels are listed below. There are small, simplified models for those just beginning this fascinating hobby, and large, fully detailed scale models for workers who have progressed beyond that stage. A complete assortment of materials is contained in each of these construction kits. A certain amount of preliminary shaping has been done on many of the hulls, and the other materials are of such sizes and shapes as to make it easiest for you to transform them into their finished form.

In addition to the ship model kits, two whittling kits are available for those who wish to take up that hobby; also two completely machined and ready-to-assemble kits for making pieces of furniture. Full-size blueprints accompany each ship model kit, and all necessary instructions are given with the others.

STANDARD SHIP MODEL KITS

A. Whaling ship *Wanderer*, 20½-in.....$7.40*
D. Spanish galleon, 24-in..... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 7.25*
L. Farragut's flagship *Hartford*, steam-and-sail sloop-of-war, 33½-in. hull..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull.... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull ..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Navy Destroyer *Preston*, 31½-in. hull 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in. hull 6.50*
4S. Clipper ship *Great Republic*, 31½-in. hull 8.40*
5S. Coast Guard patrol boat of new 165-ft. class. Full-hull model, ⅛ in. scale, the hull being 20⅝ in. long..... 4.95*



KIT 2M—Ocean freighter, 14 in. long

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in.....$1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S.S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
U. *Hispaniola*, the ship in "Treasure Island," 7-in. ..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50
3M. Yacht *Nourmahal*, 8⅛-in..... 1.00

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes..... 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high. A knife, three bottles of paint, pocket sharpening stone, and instructions are included..... 1.50

No. 8. Whittling kit for six different Scotties. Each is 2 by 2¼ in., sawed to shape. Paint, paintbrush, instructions, etc..... 1.00

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†).

Popular Science Monthly,
353 Fourth Avenue, New York, N. Y.

Please send me C. O. D. Kit.....

I will pay the postman the price shown above plus a few cents postage in full payment. (Canadian orders cannot be sent C. O. D.).

Name .....

Address .....

City..... State.....
(Print name very clearly.)

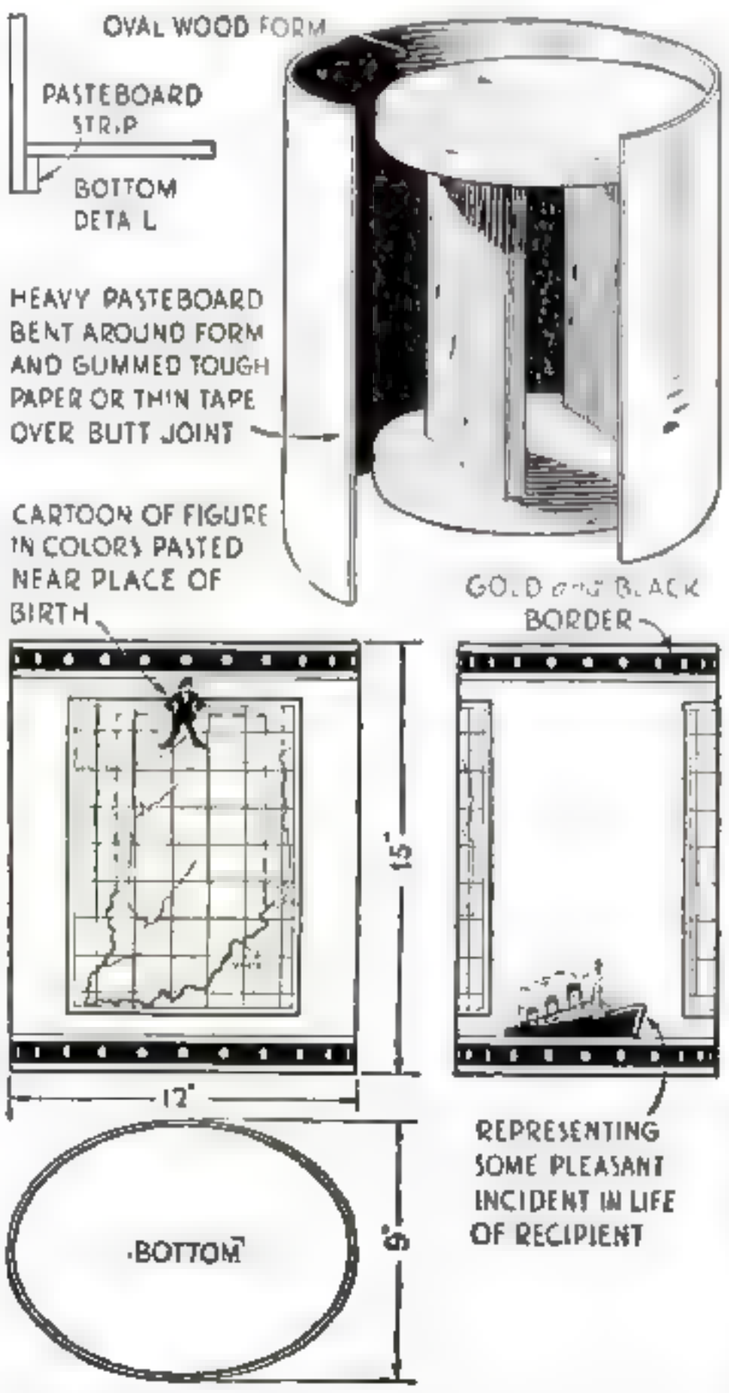
If you prefer to send your remittance with this order, we will pay delivery charges. Remit by money order, check, or registered mail. This offer is made only in the United States and Canada.

MAPS DECORATE SPECIAL GIFT WASTEBASKETS

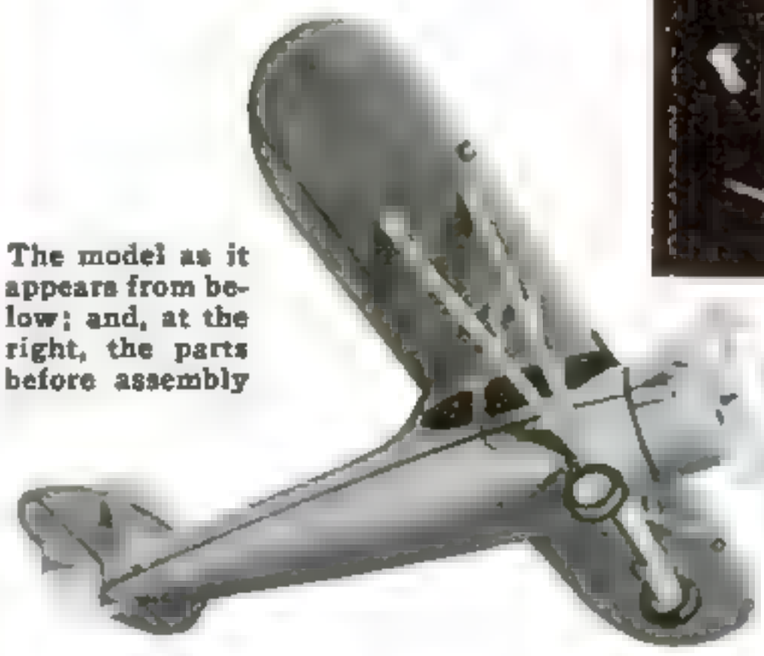
THIS unusual and decorative oval wastebasket, made by Dorothy Browne, of Monrovia, Calif., was designed for an individual couple. One side has a map of the native state of the wife, the other of the husband's.

Such a basket is easy to duplicate. In fact, if a form is made several baskets can be turned out quickly, and each decorated appropriately. Heavy pasteboard is bent around the oval form, and the butt joint is secured with tough gummed paper or tape on each side. Paper is preferred as it forms a smooth joint. If, in bending, the pasteboard has a tendency to crack, steam it where the most abrupt curve occurs, and bend very gradually.

The bottom, of the same material, is set in over a pasteboard strip. After the joints are dry, remove the form and apply the paper covering. Brush the paste on the pasteboard and smooth the paper over it. Orange paper is an effective color for the outside, setting off the maps to good advantage. The latter are clipped from an inexpensive atlas, or purchased in the single sheet.



By DONALD W. CLARK



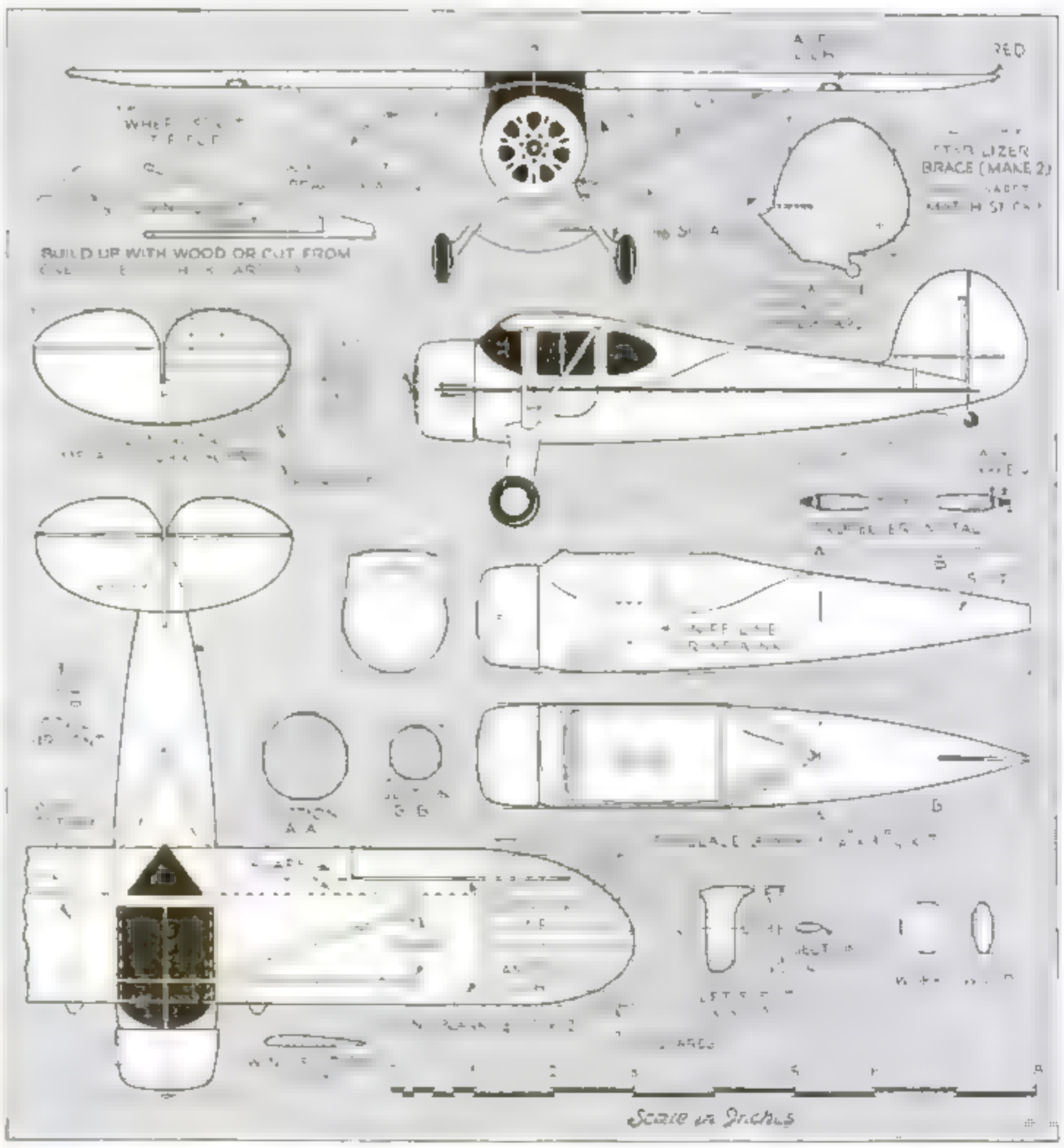
The model as it appears from below; and, at the right, the parts before assembly

WHITTLED MODEL OF A *Trim-Looking*

Cabin Monoplane

EXCELLENT performance and refinement of detail throughout are the chief characteristics of the so-called "Luscombe Phantom" cabin monoplane. The roomy cabin of this trim-looking ship seats four passengers comfortably and has an unobstructed door on each side. A 145-h.p. Super-Scarab engine gives a top speed of 168 m.p.h.; wing flaps allow a landing speed of 45 m.p.h. The wing span is 31 ft., the length is 21 ft. 6 in., and the gross weight 1,950 lb. Although the original plane is made entirely of metal, a model can be easily made from nineteen pieces of wood—eleven main pieces and eight small braces. The model is constructed on a scale of 3/8 in. equals 1 ft.

The tail mounting of the model differs from others because the horizontal unit is placed above the fuselage.



Three views of the assembled model and details of the parts. Paint the entire plane canary yellow, add the trim in dark green, and use black for the windows, tires, and cowl openings

WHITTLED CARICATURES

(Continued from page 73)

set a little back of the center of the block, looking at it from the side, and are roughly in line with the nose and about the same length.

Paint the face with oil colors—red for the lips, flesh color for the face, heightened with a touch of red on the cheek bones and nose, blue eyes with a black pupil, and brown eyebrows and fringe of hair.

THESE particular heads are made movable. Find, or whittle, an elongated wooden bead for the neck, and hollow the head slightly at the base to form a socket for one end of the bead. The shoulders are hollowed similarly to act as a socket for the other end. A piece of round elastic is locked into the head by a plug driven into a drilled hole at the base of the socket; then the elastic is fed through the bead and the socket in the shoulders, to be pulled up tight and knotted or held by a plug in a depression below.

For the shoulders take a block ½ or ¾ in. thick, 1 in. wide, and 2½ in. long, and draw on it the outline. Form the socket at the center of one edge, then whittle down toward both ends to slope the shoulders, and round off toward front and back. Remove some wood away from the chest to make the folded arms stand out. Cut V's along the arm line and a few thin V's to denote creases at the elbows and shoulders. Color in oils as before, blue for the vest, with red buttons and embroidery, and white for the shirt.

Such a figure can be used for decorating the top of a book end, a tie rack, an inkstand, paper weight, bottle stopper, or for countless other purposes. In the case of a bottle stopper, the shoulders should be narrowed considerably.

These heads can be varied in expression almost endlessly—in fact, even if you make two as nearly alike as you can, some differences in whittling or coloring will make them look decidedly different. The three little heads in the first photograph, for example, are all exactly alike except for the mouth shapes and incidental details. Tony at the left wears a hat and has shaggy hair painted on. This particular hat is turned on a lathe, the top of Tony's head is cut off, and the hat glued on. Other hat shapes are given in the drawings, including the topper, the Irish conical hat, the fedora, the derby, and a peasant cap. To form a woman's shawl headdress, simply outline the face and hair lines by cutting them a little below the surface and paint in appropriate colors.

THESE suggestions likewise apply to the side faces in the first photograph, except all dimensions crosswise of the face are shortened. In these heads, also, the side view of the nose becomes more important. Ears are usually more sharply delineated, and the dimple moves around to the side of the cheek a little more. Outlines of a face can be sawed or whittled from a thin piece of wood by following the patterns in the drawings, then finished with a few knife cuts in a somewhat similar manner to the Scotties described in a previous issue (P.S.M., Feb. '36, p. 63). Other good examples of caricature are the faces of Skipper Sam'l (P.S.M., July '35, p. 63) and Mère Marthe (P.S.M., Dec. '35, p. 68).

SCREW DRIVER HOLDS BOLTHEAD WHILE NUT IS TIGHTENED

IT IS frequently necessary to tighten a machine bolt in a corner where there is insufficient room to use a wrench. If a small slot is filed or cut in the head with a hack saw, a screw driver can be used to hold the head while the nut is being tightened.—W. PHAIR.

...THE BEST

Shop Guideposts

RELIABLE blueprints are the best guideposts you can have in your home workshop. Ever since 1922, POPULAR SCIENCE MONTHLY has been providing its readers with authoritative drawings at a nominal price. This service, the first of its kind, has grown steadily, and a large number of projects are now available. Send a self-addressed, stamped envelope for the complete list.

The blueprints, in most cases, are printed on 15 by 22-in. sheets. A partial list follows. In ordering, it is necessary to give only the numbers that are printed in italic type immediately after the titles.

RADIO SETS

All-Wave Portable (battery), *217-R* ..... .50
Amateur Short Wave Receiver, *155* ..... .25
Amateur Radio Transmitter, *183-184* ..... .50
Five-Tube Short Wave (A.C. or D.C.), *223* .25
Full Electric Headphone Set, *130* ..... .25
One Tube (battery operated), *103* ..... .25
Screen-Grid Set, *109* 25
Short-Wave Converter Unit, *137* ..... .25

FURNITURE

Cedar Chest, *17* ..... .25
Child's Costumer, *179A* ..... .25
Colonial Writing Desk, *21* ..... .25
Drafting Table, *189A* ..... .25
End Table, American Empire, *241A* ..... .25
Fireside Seats (wood and metal), *266A* ..... .25
Flat Top Desk, *20* ..... .25
Floor Lamp with Tripod Base, *243A* ..... .25
Gate-Leg Table with Round Top, *24* ..... .25
Hanging Wall Cabinet, Colonial, *280A* ..... .25
Kitchen Cabinet, *5* 25
Lamps, Three Modern, *93* ..... .25
Magazine Rack, Ladder-Back Style, *250A* ..... .25
Mirror Frame, 20 by 30 in., *246A* ..... .25
Modernistic Book Ends, Low Stand, and Bookshelf, *100* ..... .25
Sewing Cabinets, Two, *31* ..... .25
Smoking Stand, Modern, *238A* ..... .25
Stool, Scoop-Seat, *242A* ..... .25
Stool, Upholstered, *240A* ..... .25
Table, Four-Leaf Card, *239A* ..... .25
Tables, Tile-Top, *249A* ..... .25
Treasure Chests (metal bindings), *78* ..... .25

MODELS

{Construction kits are available for some of these models. See page 84.}

Aircraft Carrier *Saratoga* (18-in.) and a Flush-Deck Destroyer, *226-227-R* ..... .75
Airplane Racing Model, Twin Pusher (35-in. wing spread), *86* ..... .25
Baltimore Clipper (8-in.), wooden sails, *92* ..... .25
Battleship *Texas* (3-ft. hull), *197-198-199-200* 1.00
Bluenose, Famous Fishing Schooner (17½-in. hull), *110-111-112-R* 1.00
Clipper Ship *Great Republic* (31½-in. hull), *272-273-274-R* 1.25
Clipper Ship in a Bottle, *121-122* ..... .50
Coast Guard Patrol Boat (20⅝-in.), *286-287-R* ..... .75
Concord Stagecoach *Diamond Tally-Ho* (20½-in.), *115-116-117-R* 1.00
Constitution (21-in. hull), *57-58-59-R* 1.00
Freighter, Ocean (14-in.), *271* ..... .25
Galleon *Revenge* (25-in.), *206-207-208-209* ... 1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R* 1.50
H. M. S. *Bounty* (8½-in. hull), *254* ..... .25
Mayflower (17½-in. hull), *83-84-85-R* 1.00
Miniature Coach and Covered Wagon, for decorating boxes, etc., *202-R* ..... .50
Motor Boat, Working Model (20-in.), *196* .... .25
Nourmahal, power yacht (8⅛-in.), *276* ..... .25
Liner—*California* (12½-in.), *251* ..... .25
Liner—*Normandie* (20⅝-in.), *264-265* ..... .50
Liner—*Queen Mary* (10¼-in.), *283* ..... .25
Pirate Felucca (20-in.), *44-45-R* ..... .75
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in hull), *228-229-230-R* .. 1.00
Roman Galley (19-in.), *138-139-R* ..... .75
Santa Maria (18-in. hull), *74-75-76-R* 1.00
Seaplane, Tractor Model (30-in. wing spread), *87* ..... .25
Sea Witch, Clipper Ship (9⅛-in. hull), *219* .25
Steamboat, Mississippi (19½-in.), *94-95-96-R* 1.00
Trading Schooner (17⅛-in. hull), *252-253* .50
Tugboat, Harbor (11¾-in.), *284* ..... .25
Tugboat, Water-Line (5 3/16-in.) and Barge (7 3/16-in.), *285* ..... .25
Viking Ship (20½-in.), *61-62-R* ..... .75
Whaler—*Wanderer* (20½-in.), *151* to *154* 1.00
Winnie Mae, 4-ft. Flying Scale Model, *141-142-143* ..... .75
Yacht *Rainbow* (7½-in. hull), *233* ..... .25
Yacht (20-in. racing), *48-R* ..... .50

BOATS

Canoe, 16-ft. Canvas-Covered Kayak, with sail, etc., *192-193-194-R* 1.00
Combination Boat, 15-ft., for sail, outboard motor, or oars, *131-132-133-R* 1.00
Duck Boat, Canvas-Covered (13 ft. 6 in. long; weighs 60 lb.), *279-R* ..... .50
Duck Boat, Folding, (13-ft.), *170-R* ..... .50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), *257-R* ..... .50
13-ft. Motorboat-Rowboat (has decked hull; for use with outboard or inboard drives and oars), *147-R* ..... .50
Utility Boat for Campers (11 ft. 2 in. long, canvas covered; for rowing or outboard motor), *281-R* ..... .50

MISCELLANEOUS and TOYS

Acrobatic Monkeys Toy, One-Legged Table, etc., *248* ..... .25
Block Puzzles, Six, *65* ..... .25
Colonial Design Doll's House, *72* ..... .25
Doll's House Furniture, *73* ..... .25
Hand Loom, Four-Treadle, *268A-269A* ..... .75
Microscope Kit, Portable, *220* ..... .25
Perpetual Star Chart, *214* ..... .25
Projector for Photos and Pictures, *259A* ..... .25
Toy Birds and Animals, Jig-Sawed, *56* ..... .25
Toy Drill Press, Lathe, Saw, etc., *113* ..... .25
Toy Dump Truck, Fire Engine, etc., *101* .... .25
Weather Vane, Ship Model Type, *66* ..... .25

Popular Science Monthly
353 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

.....

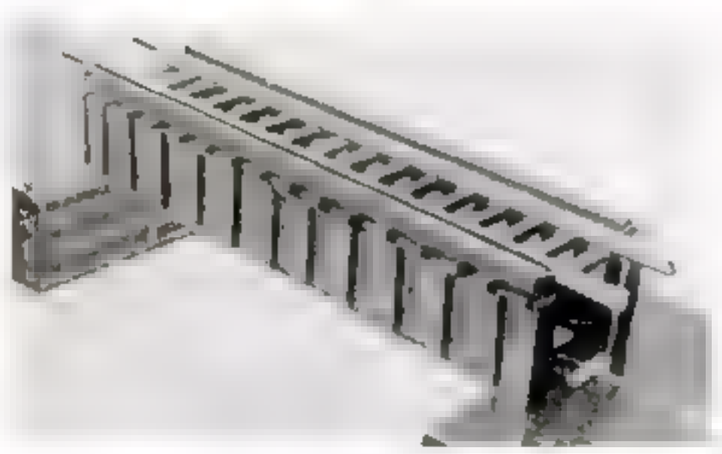
I am inclosing..... dollars, ... cents

Name .....

Street .....

City and State.....
Please print your name and address clearly.

GRADE-CROSSING BRIDGE FOR MODEL RAILWAY



Deck-plate girder bridge for O-gauge railway

IN THESE days of grade-crossing elimination, model railways, like their large prototypes, are hardly complete without one or more small bridges. The deck-plate girder type of bridge illustrated is a common, well-standardized design.

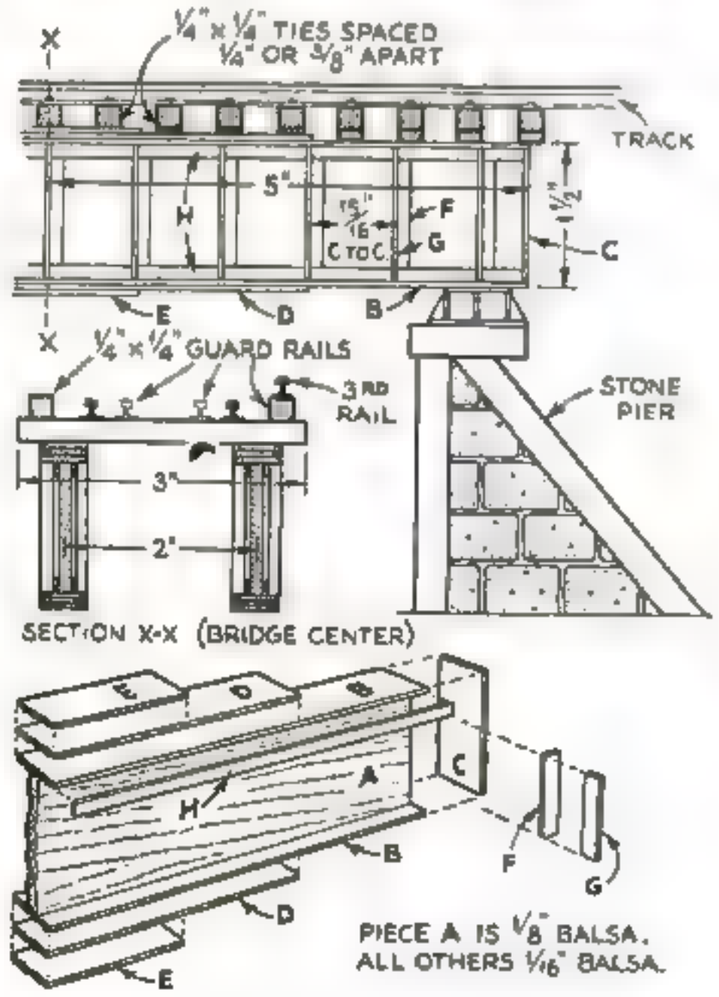
Although other woods may be used, balsa wood was chosen for building the model because it has the advantage of being available in suitable thicknesses. If you find it desirable to change the bridge length, alter the depth and panel widths in the same proportion. Real bridges of this type have a system of cross-bracing between the two girders, but this is almost invisible, and is eliminated in the model by cementing the ties to the top.

The main vertical panel *A* of each girder is cut from 1/8-in. or thicker balsa and is 9 7/8 by 1 3/8 in. All other parts are 1/16 in. thick. Parts *B* and *C* are added next, then strips *H*. Finally, pieces *F* are cemented in place and, above them, strips *G*. Note that the pieces *D* and *E* do not extend the full length of the bridge, and consequently there is no level surface upon which the ties may be laid. In real practice the ties are notched at the ends to compensate for this difference in level. However, on the model it is better to cement blocks of wood under some of the ties.

It is a good idea to make the cross ties from balsa, too, because if they are made from a harder wood, it is difficult to drive the spikes in. To make the spikes hold firmly in balsa, dip them in cement.

Either or both of the two types of guard rails shown may be used. The metal ones, which on real railroads are made from worn-out running rails, are extended and bent so that they meet at the center of the ties.

Paint the completed model flat black and, if desired, letter the name of your railroad in white.—CARL FROEN.



HOW TO ETCH HALF-TONE ENGRAVINGS

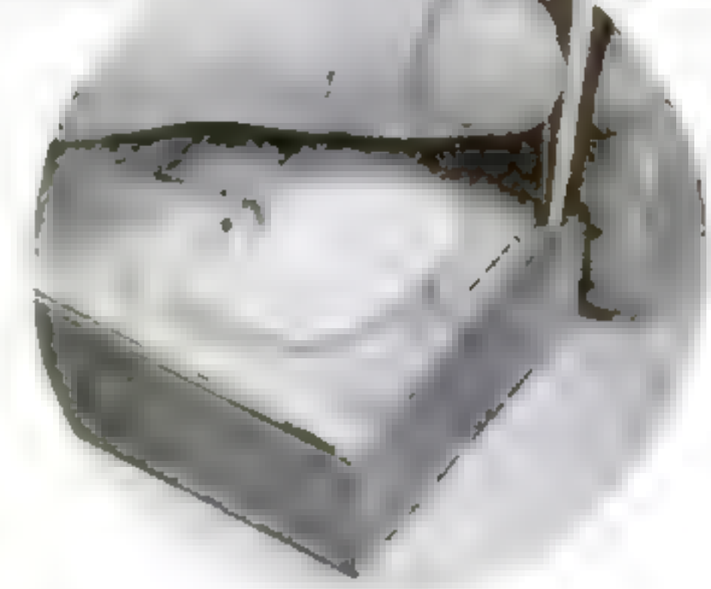
(Continued from page 79)

then hold it on an incline and brush off the powder with downward sweeps of the brush. The resin will be piled up against the upper side of each dot, but is brushed off the remainder of the plate. Heat it to set the resin; then cool and repeat the same operation with the plate held in the other three positions so as to protect the other sides of the dots.

Wet the plate and replace it in the tub, but examine it occasionally with the magnifier to see that none of the finer dots are being eaten away. The etching should progress to a depth approximately equal to that of a visiting card. Rinse the plate in water, dry, and scrub off the resin with benzine and a brush.

Etching is best learned by practice, although the beginner should get fair results the first time. The acid should flow back and forth over the plate regularly, and it is particularly important to watch the finest dots.

When they appear to be etched as much as they can stand, without danger of being eaten away, it is time to take the plate from the tub, rinse, dry and powder with resin again. When powdering four ways, to protect all sides of the dots, be sure to melt the resin by heating the plate between each powdering.

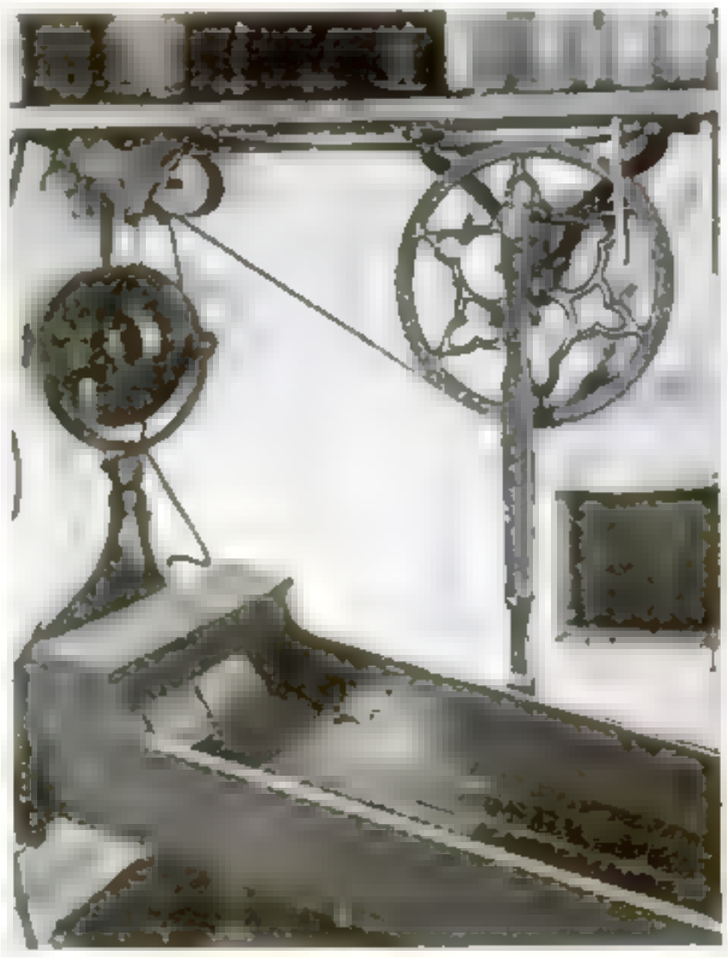


On a drill press set for highest speed, two edges of the plate are routed so that it can be nailed to a block. Then the surplus zinc is trimmed away on the scroll saw as shown above. Finally, the routed edges are bradded to the wood block

Also be sure that none of the grains of resin adhere to the etched spaces between the dots.

After the finished half tone has been cleaned with benzine, it can be rubbed with a block of magnesium carbonate to fill in the spaces between the dots; this will allow you to see how the half tone will look when it is printed. Remove the magnesium with a brush before printing from the plate.

Trimming and mounting. Trimming can be done with a metal-cutting blade in the scroll saw, but two of the sides should first be routed, as shown in one of the illustrations, for nailing to the mounting block. Use very small brads for nailing the plate to the wood block. Examine the edges of the plate for roughness, and smooth them down with a file. A "type high" gage is a convenience and is not expensive. If the blocked cut is not quite type high, you can add pieces of gummed paper to the bottom of the block. Most newspapers have old advertising "cuts" lying about. If you can get some of these, they will provide plenty of blocking material, most of which is of the right thickness to bring your 16-gauge zinc plates up to exactly the right height.



A fan motor, set of reduction gears, and an old sewing-machine treadle wheel are used to make this power rocker for the etching tub

FLAP OF WALL PAPER CONCEALS OLD NAIL HOLE IN PLASTER

When it is necessary to drive nails or screws into walls covered with wall paper in order to hang up picture frames, first cut a small triangle in the paper at the point where the hole is to be made and dampen the spot. Then pull the flap away from the wall and bend it down. If it is desired to remove the nail or screw later on, the paper can be bent back and pasted.—Emil J. Novak.

WAX PRESERVES LEATHER LACES

Before lacing any leather craftwork articles, rub the lace firmly over beeswax or paraffin until the underside is coated; then polish the leather with your fingers. This will prevent the underside of ordinary beveled laces from cracking.—A. W. Moreau.

OLD AUTO TRANSMISSION SERVES AS WINCH

(Continued from page 64)

mechanism shown, a 1-in. pipe was used as it just fitted over the end of the transmission driving shaft.

A in Fig. 4 is the flange next to the transmission, and *C* is a disk of hard wood riveted to *A*, both cut with notches for the ratchet. The two are riveted to a sheet-metal disk *D*, which in the present case was made of No. 18 gauge black metal, 6½ in. in diameter. Flange *B* at the outer end of the drum is riveted to a similar disk.

A short piece of 1-in. shaft *E* is driven into the drum spindle to form an outboard bearing supported by the bracket shown in Fig. 3. The drum is attached to the transmission drive shaft by means of a 5/16-in. pin through hole *G*, which is drilled through the pipe after it has been forced onto the shaft.

Figure 1 shows the metal block with a pin for the dog in Fig. 2. The holes in the block were drilled and spaced to fit stud bolts in the transmission casing. The block would have to be designed differently for some other transmission, but in any case should be attached rigidly to the casing in such a way as to allow the dog to engage the ratchet teeth. The removable crank was made from a starting crank by welding on a square socket that slips over the square end of the shaft entering the transmission.—GEORGE B. COUPER.

NOVEL CAT-TAIL LAMP

(Continued from page 66)

prepared to hold them together at the bottom. The leaves are all soldered inside this band, leaving a hole in the center for the stem to go through.

The stem of the cat-tail is made of two-wire, lead-covered cable. A short scrap of this cable usually can be obtained free at the electric shop where you buy the sockets. The ends of the wires are stripped at both ends of the cable. The cable is flat, and the upper end must be rounded so that the socket cap can be screwed on. This cap will screw on the lead covering without cutting threads beforehand. The socket is connected to the wires and is held in an upright position by the cap. The cable is then passed down through the hole in the leaves and through the base and is brought out at the back. The two cables are spliced together when both are in place, and two ends are left for attaching the extension cord. These cables must be fastened with a metal strap and screws so that the stems will remain rigid.

The leaves of the arrowleaf and rushes can be of stiff paper painted green or they also may be of sheet metal. They are fastened into small holes drilled into the base.

The rocks on the rim and the back of the pool are painted white or gray. When dry, the joints are pointed up with black. The water in the pool is blue-green, and the lily leaves a light green enamel. This gives them the slick-looking surface of real leaves. The stems of the cat-tails and rushes are painted with green enamel, as are the sockets.

The cat-tail heads are long light bulbs that have a pointed tip resembling those on real cat-tails. These may be tinted with a water dye to make them brown, or they may be left in the lighter color, depending on how much light you wish them to give.

When the painting is done, the flowers of the lilies are added. They may be waxed paper such as are sold at variety stores. China frogs, water birds, and other water visitors, if obtainable, will add interest to the set, but must be arranged so that the effect is artistic and does not give the impression of being cluttered.—D. C. MARSHALL.

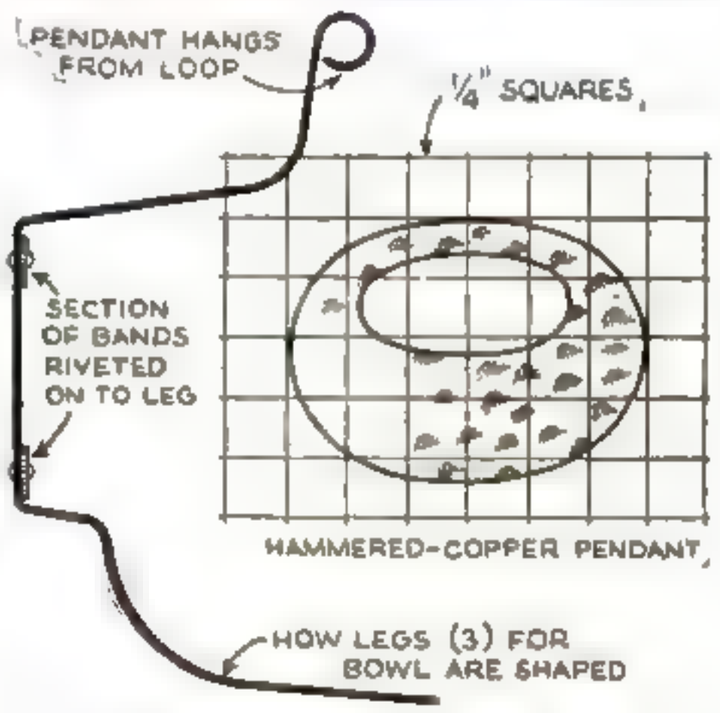
CANDY BOWL HAMMERED FROM SHEET COPPER

THE bowl for this candy dish is made from an 8-in. disk of 16-gauge soft sheet copper. The receptacle rests in a graceful stand of the same material and is removable

Hold the disk on a steel block as illustrated at the bottom of this column, and with a ball-peen hammer begin hammering about 1½ in. from the edge, driving each blow toward the edge. Work around on the inside, cupping the piece as much as possible. Heat the piece to a cherry red and plunge it into water; then repeat the hammering. By this time the depth should be about 1¼ in. True the piece up and file the edge smooth.

The three legs are ½ by 9 in., hammered and bent to shape as shown. A pendant is attached to the loop in each piece. The two bands are ⅜ by 10¼ in., hammered, formed into rings, and riveted together. The legs are evenly spaced, and the rings riveted on with brass escutcheon pins.

Dissolve a small *(Continued on page 93)*



The shape to which the ½ by 9-in. legs are bent, and a pattern for cutting the pendants

Begin hammering about 1½ in. from the edge, and work around so as to obtain a cup shape

HAMMERED CANDY BOWL

(Continued from page 92)

The legs, riveted to two bands of ¾ by 10¾-in. stock, form a steady support for the bowl

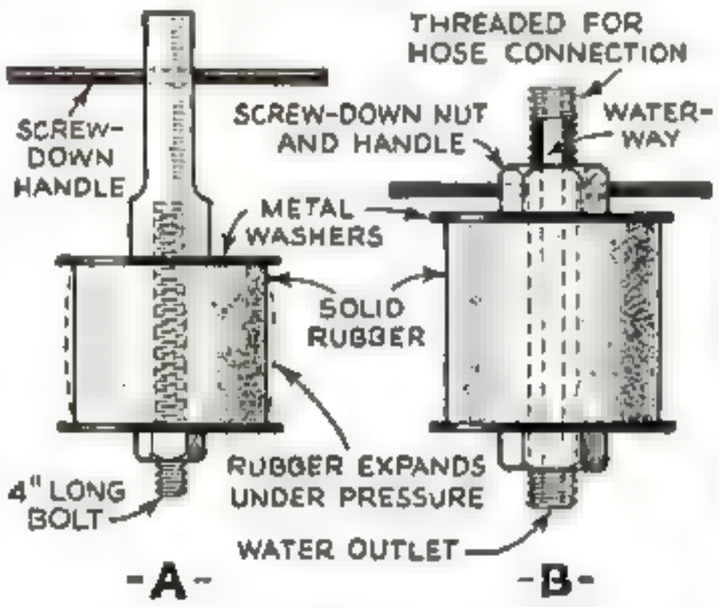
piece of liver of sulphur in about a gallon of water, and immerse the stand until it turns brown. Then wash and dry it. With a piece of cloth, apply the same solution to the outside of the bowl until brown. Do not color the inside.

Wash the bowl well and let it dry. As the last step, polish both pieces and apply lacquer.—WILLIAM KORTS.

PLUGS HELP IN FINDING LEAKS UNDER PRESSURE

TWO useful varieties of homemade rubber expansion plugs that will withstand pressure up to 100 lb. a square inch are illustrated below. The first *(A)* is used simply to plug a hole. The second (*B*) is designed for finding leaks under pressure and may be used for testing pipe lines, hot-water radiators, heating systems, and automobile radiators. With its aid each length or section can be tested separately under the actual working pressure.

A 4-in. long bolt of any convenient diameter, with the head cut off, is used in making



Two types of expanding rubber plugs. *A* is for stopping leaks, and *B* for making tests

A. When the handle is turned down, the pressure on the metal washers causes the rubber to expand evenly in all directions. The handle illustrated was turned on a lathe, but if no lathe is available, a handle similar to that used on *B* may be used.

In making *B*, either a pipe, threaded from end to end, or a bolt drilled through the center may be used. For greater strength, it is better to drill a bolt, because this gives a thicker wall than can be obtained by using pipe. The rubber piece is solid, except for the hole through the center.

If the plugs are to be used in water, it is well to remember that the water will cause the rubber to expand; consequently, the rubber should be at least 1/8 in. smaller than the hole. By using different sized rubbers, these devices can be adapted to holes of various sizes. Once the rubber is in and the pressure has been applied, it is almost impossible to dislodge the plug.—W. PHAIR.

Yacht-Race WINDMILL

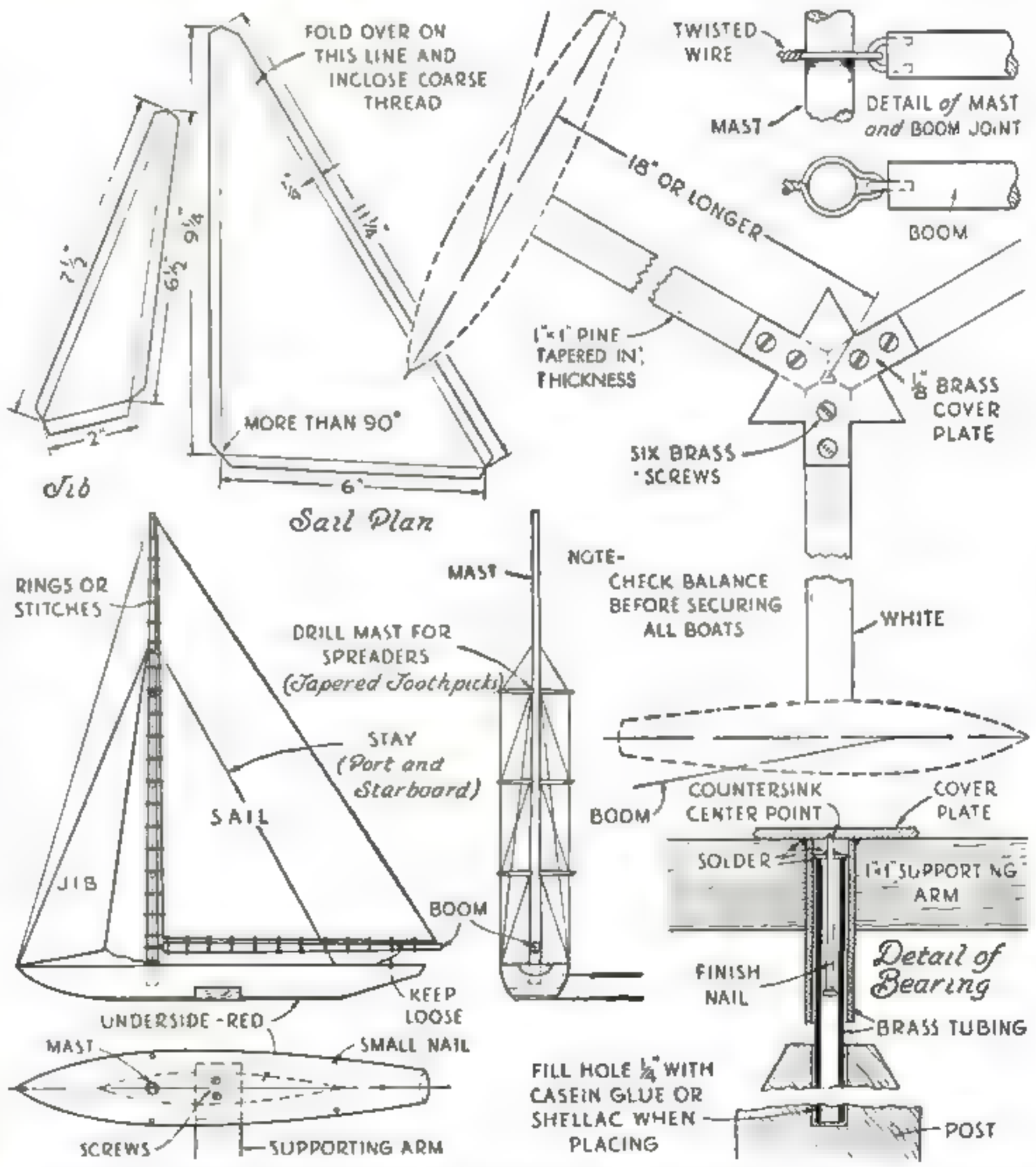
...A Cape Cod Novelty in Which Three Little Boats Go Round and Round

A NOVEL Cape Cod windmill in which three miniature yachts appear to be sailing an endless race can be easily constructed as shown. Although any design or number of sailboats may be used, the type illustrated gives the most even rotation, and an odd number of vessels presents a better picture when viewed from a distance.

The sails should be made to the size shown before they are attached to the masts and booms with rings or half-hitch stitches. To save work, the booms may merely be slipped through hems in the sails.

A simpler type of bearing may be used, but the balance must be correct to insure perfect rotation. Countersink the bearing first and use the countersunk spot as a center point for laying out the brass cover plate. When the necessary lines are scribed, solder 3 in. of tubing to the plate. There must be twice as much tubing in the post as exposed. Graphite is used for lubrication. The deck, spars, mast, and boom are left in natural color; side of hull, white; water line and underside, bright red.

By **WILLIAM J. TURNBULL, JR.**



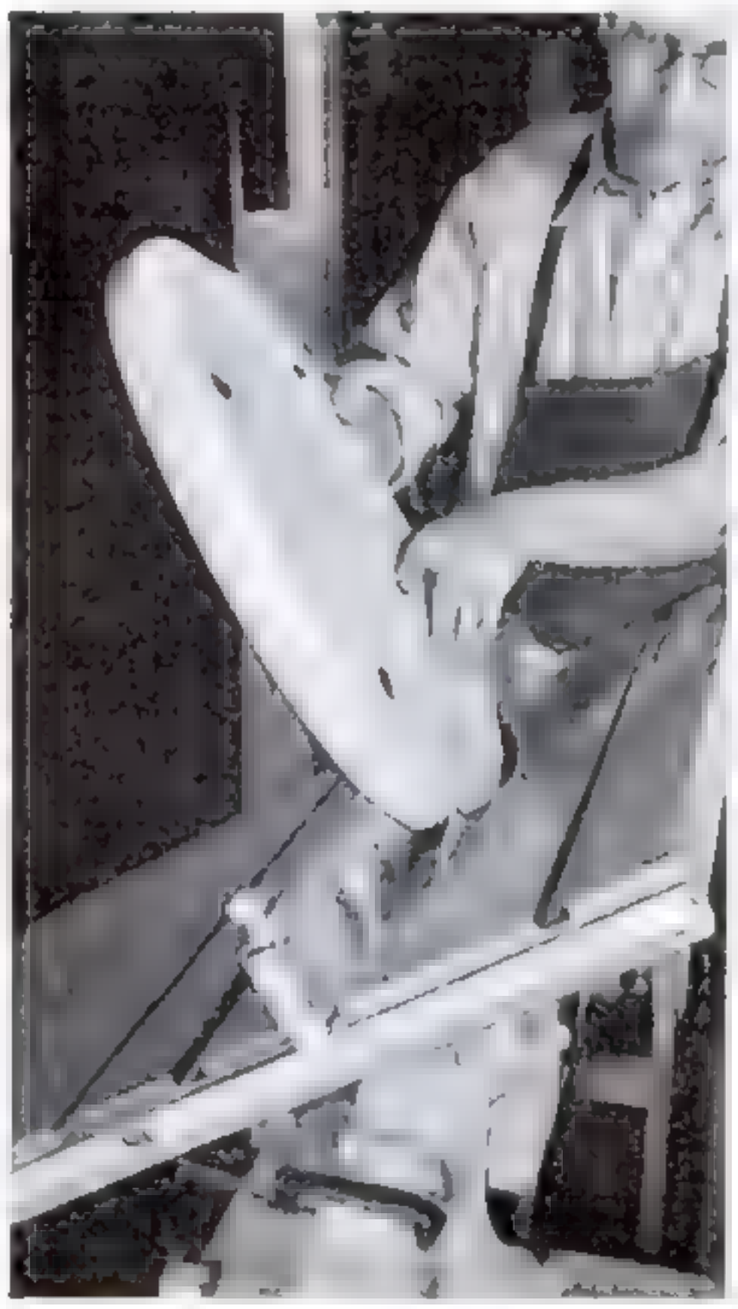
The hulls are ¾ by 1½ by 9 in.; masts, 10 in. above deck; booms, 6⅛ in. long; arms, tapered

CRICKET WITH ROCKERS

(Continued from page 67)

adapting an ordinary bit for the drill press, it is advisable to file off the conical threads on the pilot.

The surfacing of the top cannot very well be done by planing, if figured wood is used, as the grain is too irregular. Use a sanding machine or a cabinet scraper, as shown in one of the illustrations. Then band-saw the wood to shape and round the edge. Most of the wood on the lower edge may be trimmed off on the circular saw tilted to 30 deg. In this operation be careful not to roll the top—push it straight forward so the saw will not jam, and take many successive cuts to get the



In rounding the top edges, much of the waste stock may be removed on a circular saw table

curved outline. Block plane, wood rasp, sandpaper, and scraper may be used to finish the edge to the proper contour.

Make the turned legs next, fitting them to the top. When they are in position, check the distance between each pair near the bottom (the dimension marked 8¾ in. on the end view). With this checked dimension, locate the holes to be bored in the rockers, as soon as the rockers have been dressed to outline. The necessary holes at these points may also be bored on the drill press by tacking leveling blocks under the rockers. The waste pieces from which they were sawed may be used for this purpose. Tilt the drill-press table to the same angle as before, and on it clamp the rockers at a 45-deg. angle with the slope of the table.

After all rounding of edges and sanding have been done, the legs may be glued in the top. Secure them with wedges driven in a saw cut in their upper ends. The lower ends must be sprung together slightly to enter the holes in the rocker.

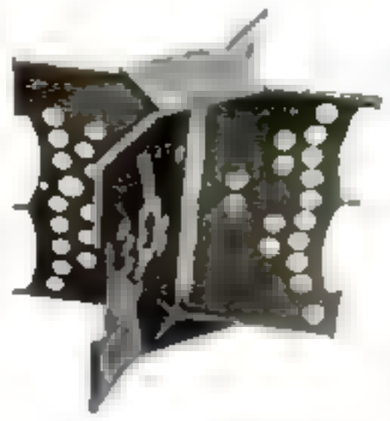
A desirable finish for this piece is a water stain to bring out the grain pattern, with two coats of varnish, rubbed down with pumice stone and waxed.—DONALD A. PRICE.

SUBSCRIBERS *are requested to notify us of change of address four weeks in advance of the next publication date.*

REEL ADAPTS CUT-FILM TANK FOR ROLL FILMS

(Continued from page 82)

by 1/16 in. after holes have been drilled large enough to prevent splitting. The author used some liquid solder to cover the screw heads and to reënforce the intersection of the slots in the frames. One safety pin is straightened out and formed into a hook as shown. The circulation holes are drilled after the frames and hooks are assembled.



The finished reel with holes for circulation

Those who work with panchromatic film will appreciate the ease and simplicity of loading the reel in total darkness. The protecting paper is unrolled to the end of the film, which is attached to the hook. The film and paper are then wound spirally in the notches until the second end is reached. The paper may now be removed and the safety pin attached, leaving the reel and film ready for the developing tank.—ELTON C. CLINE.

WATER-TIGHT CAN HOLDS CAMERA ON CANOE TRIP

WHEN an expensive camera is to be carried in a canoe or light boat, it pays to provide an air-tight can such as a cracker can to serve as a carrying case. To demonstrate the value of this idea, a small camera was put in a cracker can, a weight was attached, and it was lowered with a rope to a depth of about 20 ft. The rope and weight were so fastened that when the rope was cut, the weight fell loose from the can, which bobbed up to the surface within a few seconds, carrying the camera undamaged.—JOHN J. CAMERON.

MAKING REALISTIC PLATFORMS FOR MODEL RAILWAY STATION

RAILROAD-station platforms of asphalt and other paving compositions can be imitated quite easily by model railway fans in two different ways. The first method is to cut boards of pine or other softwood to the size and shape of the platform and runways and then cement black emery paper on the boards, leaving a border to simulate the concrete edges. The borders may be painted white. The second method is to paint the platform with black paint and sprinkle on fine sand before it dries. Real platforms should be examined to determine the scale thickness of the miniature platform.—C. A. CORRIGAN.

CHIPPED ENAMELWARE REPAIRED WITH ALUMINUM PAINT

WHEN the enamel starts to chip off the bottom of a dish pan or other enamelware utensils, a fairly durable repair may be made with aluminum bronzing powder. Rub clean the spots where the enamel has come off, pour on them a little of the bronzing liquid, and hold over the gas flame until the metal gets quite hot. Then sprinkle on some of the aluminum flakes and hold over the flame until the silvery color changes to light brown. Remove any loose flakes that remain with a dry cloth.—C. B. GASKELL.

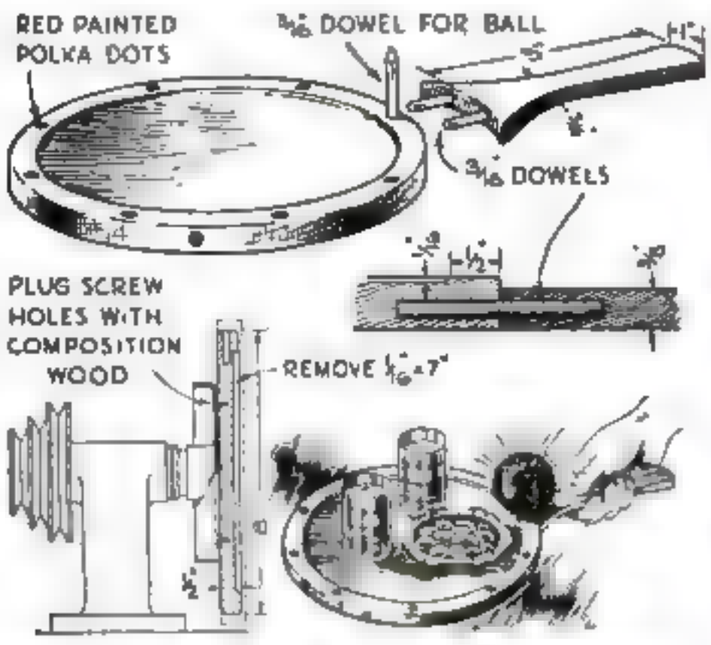
ROPE CURES SWEATING PIPE

WHEN a water pipe in the basement sweats and drips under certain atmospheric conditions, the difficulty can be cured by coiling around it a length of discarded clothesline, which will insulate it from the air.—J. M.

ONE-HANDED TRAY MADE FOR SERVING SNACKS

A UNIQUE serving tray for between-meal snacks is illustrated below. It is simply a turned wooden disk with a handle and a sponge-rubber ball in which are thrust varicolored toothpicks for lifting squares of cheese, olives, "rollmops," or what have you from the tray.

Gumwood has a beautiful grain and is well adapted for making this piece. Cut a disk



How the tray is constructed and used. The sponge-rubber ball holds colored toothpicks

roughly from 9/16-in. surfaced material, about 8¼ in. in diameter, and secure it to a faceplate with short, blunt screws. Take care that it is drawn up tightly. Turn the outside rim and then cut a depression in the face of the disk 1/16 in. deep and 7 in. in diameter. Smooth with sandpaper or, preferably, fine garnet paper.

It is a good idea to drill the holes for the dowels while the rough stock is in the square. The dowels and joint should be fastened with glue of the best quality. Drill for the dowel that is to hold the sponge-rubber ball, but do not set it in permanently until the wood has received the final finish. This consists of four coats of shellac with a fine-grade sandpaper treatment after the first, then steel-wool rubbing after the second and third. The ball can also be shellacked and glued to the dowel. Before the last coat of shellac, paint red polka dots on the rim as indicated.—DICK HIXON.

SPRING-BRASS ROCKERS USED ON BLOTTERS

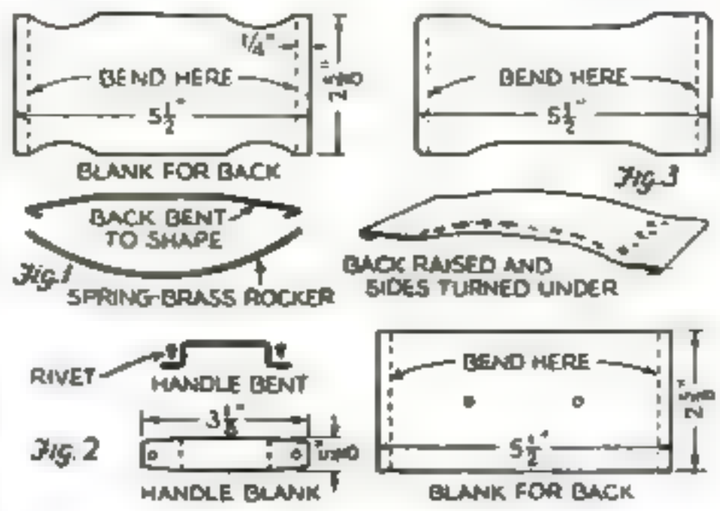
Three hammered-metal blotters of simple construction with rockers of thin spring brass

THESE rocker blotters differ from those usually made by amateur craftsmen in that the rockers are of spring brass.

The back of the rocker shown in Fig. 1 on the following page, is of 18-gauge soft sheet brass and is raised so that the sides act as a handle. That in Fig. 2 is of 18-gauge soft sheet copper and has a handle riveted on. The one shown in Fig. 3 is of 22-gauge soft sheet copper, and the back is rounded up to overcome the necessity of making a separate handle. All three pieces are hammered. The rockers are of *(Continued on page 98)*

METAL ROCKER BLOTTERS

(Continued from page 97)



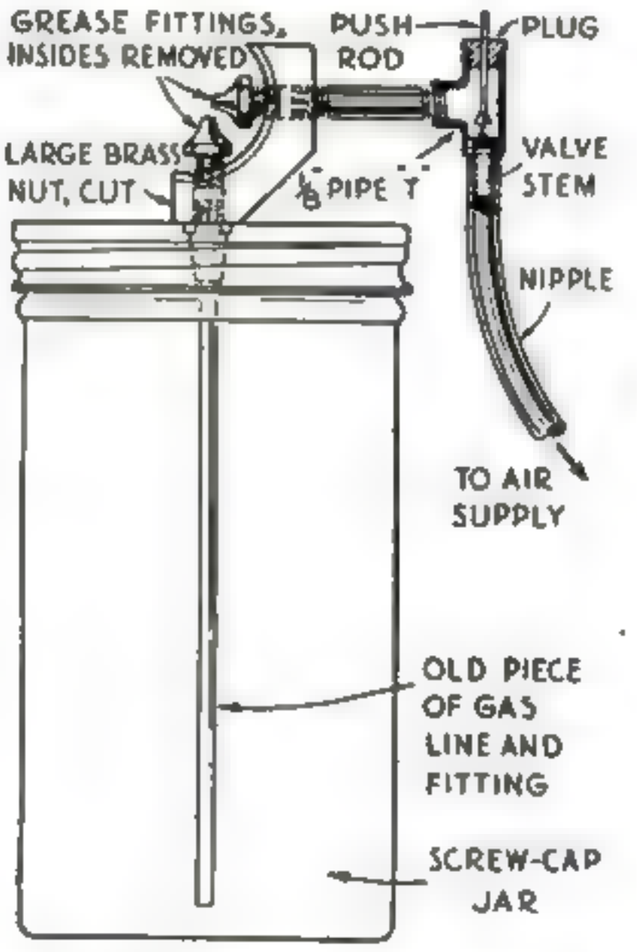
Three designs for blotters. The blotting paper is cut so the rockers hold it in place

22-gauge spring brass, 2⅝ by 5¼ in. They are not hammered.

The two copper pieces are colored brown by immersing them in a solution made by dissolving a small piece of liver of sulphur in about a quart of water, after which they are washed, polished, and lacquered. The brass piece is polished and lacquered.

To finish the rockers, place ten cents worth of commercial nitric acid in a glass jar, and put into this all the scrap copper the acid will consume. Use a swab to coat each piece with the solution; then heat until they turn black. Finally polish and lacquer them. Be careful not to get any of the acid on the hands or clothing.—R. J. Hughes.

SMALL PAINT GUN MADE FROM ODDS AND ENDS



HERE is a suggestion for making a small utility paint-spraying gun from junk. A large brass nut was cut so that there would be two sides at right angles. Two pressure grease fittings with the insides removed then were tapped in at right angles. The ⅛-in. pipe thread on them also allows for minor adjustment. The top fitting was tapped from outside for a ⅛-in. piece of pipe, which carries a pipe T on the outer end. The pipe T was plugged at one end, and a push rod inserted to operate the valve. An old ture valve was cut off and soldered inside the nipple leading to the gun.

The fitting in the jar depends on the size of the old piece of gas line tubing used.

The advantage of this gun is that it will operate on 75 or 80 lb. pressure very well, whereas a regular gun must have the pressure regulated.—P. T. Potter.

IRREGULAR CURVES MADE FROM THIN CELLULOID

SOONER or later every draftsman has large, flat curves to draw that are beyond the reach of ordinary irregular curves. However, curved guides of great length and extreme flatness can be made from sheet celluloid of the kind sold for automobile curtain lights.

Two classes of curves can be drawn without much trouble—elliptical and spiral. For the first, stretch the celluloid on a large drawing board, pinning it near the lower edge with two thumb tacks placed as far apart as convenient. Cut a piece of small copper or fine steel wire, and tie the ends to the tacks. Leave as much slack as is desired. To draw the curve, use a sharp-pointed scriber, such as a phonograph

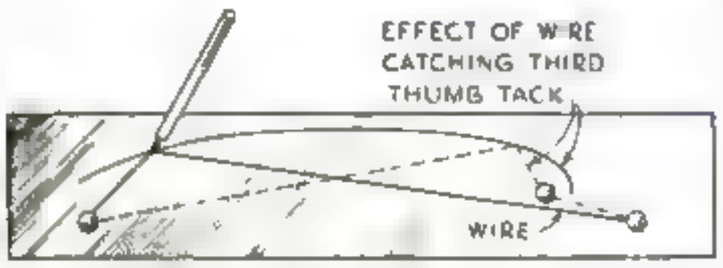
Drawing special curves is a simple matter if suitable guides are cut from thin celluloid

needle or darning needle set in a wooden handle, with a notch filed near the point in which the wire can run.

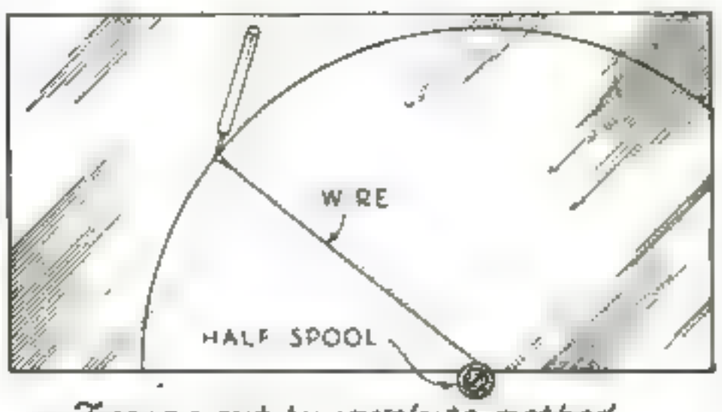
Now hook the wire in the notch, holding the scriber like a pencil, but with a finger over the notch to keep the wire in, and stretch the wire firmly. If a line is scratched from left to right, a half-ellipse will result. Since it is better to have the ends unlike, press a thumb tack in a short distance to the left of the right-hand tack and a little above a straight line joining the left- and right-hand tacks, and the wire will bear against this tack as the scratch lengthens toward the right. The line will then sweep smoothly into a shorter elliptical curve. For other curves, inside and out, vary the length of the wire, also the distance apart of the tacks.

Cut out the curve with scissors. If you have trouble in seeing the scratch, trace along it with a grease pencil, and rub the pigment into the line and off the surface with a cloth, which will make the line show black. You will find that you can cut the curve very accurately; and the local bumps, if any, can be taken off by a little judicious rubbing with a fine flat file by rocking it along the edge.

If elliptical curves *(Continued on page 100)*



Laying out by ellipse method



Laying out by involute method

Diagrams illustrating two methods of laying out the special curves with the aid of wire

MAKING SPECIAL CURVES

(Continued from page 99)

do not furnish enough variety, use an involute or spiral. Cut a spool in half and screw one end to the drawing board. Cut a wire about 2 ft. long, secure it to the spool, and wind it around several times. Tie a loop in the other end, and use it as a compass for scratching the line. As the wire unwinds from the spool, the radius constantly increases, making a section of a spiral. You can vary the curvature by using spools of different sizes, and by winding on more or less wire before starting to make each curve.—EDWIN M. LOVE.

Small special curves can be made in the same way and the celluloid fastened to a piece of cardboard with rubber cement to stiffen the curve and lessen the likelihood that any ink will run under the edge. Cut the cardboard about 1/16 in. smaller than the celluloid so that the edge of the latter will project beyond it.—LESLIE KINNING.

SLIDING PUSHER BLOCK FOR CIRCULAR SAW

The block is shaped at the bottom so as to hook over the end of the board to be sawed

SLIDING lengthwise on the ripping fence, this pusher block eliminates most of the danger in ripping small, narrow strips of wood on the circular saw. With the usual pusher stick there is always a chance that the stick will slip or come into contact with the blade, while with the sliding block this is impossible and the right hand is out of the way, on the opposite side of the fence.

The block is made to fit over the fence, one side being formed of a separate piece of wood that is adjusted for height with a wing nut and bolt. After setting the block for the thickness of the wood being cut, merely push it forward on the fence.—E. A. BOWER.

By means of a bolt and wing nut, the block is adjusted to suit the thickness of the wood

PREPARING LEAD-COVERED WIRES TO PULL THROUGH CONDUIT

WHEN it is necessary to pull several lead-covered conductors into a conduit, much less effort is required if the conductors are first taped together parallel with short pieces of tape every 2 or 3 ft. and the single assembly thus formed is then well served with soapstone or cup grease.—LOUIS N. GOODMAN.

NOW'S YOUR CHANCE TO JOIN THE GUILD FREE

(Continued from page 65)

(2) Regular meetings, at least ten times a year. (3) A pledge that all activities will be undertaken to help members maintain and develop their interest in craftwork and to promote the homeworkshop hobby. (4) A strictly noncommercial attitude in respect to all club affairs. (5) A report of all new members.

The Guild itself is a noncommercial and nonprofit organization, the administrative expenses of which are defrayed by POPULAR SCIENCE MONTHLY, the official Guild magazine. Nationally known leaders in various fields serve on its Advisory Council—Frank A. Vanderlip, Harvey Wiley Corbett, Dr. Hugh S. Cumming, Prof. Collins P. Bliss, Maj. Gen. Benjamin D. Foulois, Capt. E. A. McCann, Dr. Francis G. Pease, and Prof. Clyde A. Bowman.

If you, too, would like to share in this great home workshop movement and take advantage of the opportunities that it holds for every enthusiastic craftworker, send the coupon at once for detailed information.

WHERE HOME WORKSHOP CLUBS ARE LOCATED

(Continued from page 65)

KENTUCKY
- Covington
- Lexington
- Louisville

LOUISIANA
- Shreveport

MAINE
- Brunswick
- East Machias

MARYLAND
- Boonsboro
- Hyattsville

MASSACHUSETTS
- Boston (Model R. R.)
- Brockton
- Fall River
- Lawrence
- Lowell (2)
- New Bedford
- North Adams
- Orange
- Roxbury (2)
- Springfield
- West Lynn
- Worcester

MICHIGAN
- Detroit
- Flint
- Mt. Clemens
- Muskegon
- Saginaw
- Walla Walla

MINNESOTA
- Detroit Lakes
- Minneapolis
- Red Wing

MISSISSIPPI
- Brookhaven

MISSOURI
- Mansfield
- Rolla
- St. Joseph
- St. Louis (3)

MONTANA
- Billings
- Great Falls
- Miles City
- Paradise

NEBRASKA
- Alliance
- Lincoln
- South Sioux City

NEW HAMPSHIRE
- Dover
- Manchester

NEW JERSEY
- Collingswood
- Elizabeth
- Hoboken
- Kenilworth
- Maywood
- Morristown
- New Egypt
- Paterson
- Wood-Ridge

NEW YORK
- Brooklyn (2)
- Buffalo
- Cooperstown
- Dunkirk
- Elmira
- Freeport
- Hornell (2)
- Le Roy
- Mount Vernon
- New York City (5)
- Niagara Falls
- Patchogue, L. I.
- Peekskill
- Rochester
- Syracuse

NORTH CAROLINA
- Charlotte

NORTH DAKOTA
- Fargo

OHIO
- Ashtabula
- Cincinnati (2)
- Cleveland
- Maumee
- Newark
- Toledo
- Zanesville

OREGON
- Eugene
- Roseburg
- The Dalles

PENNSYLVANIA
- Chester (2)
- Easton
- Erie
- Fair Oaks
- Indiana
- Kutztown
- Norristown
- Philadelphia (2)
- Pittsburgh (3)
- Scranton
- Sharon
- Sharpsburg
- Stroudsburg

TENNESSEE
- Chattanooga
- Memphis

TEXAS
- Kingsville
- Lamesa

UTAH
- Provo

VIRGINIA
- Hampton Institute
- Norfolk
- Richmond
- West Point

WASHINGTON
- Coulee Dam
- Spokane (2)
- Tacoma
- Yakima

WEST VIRGINIA
- Beckley
- Bluefield
- Fairmont
- Fayetteville
- Missouri Branch

WISCONSIN
- Cudahy
- Kenosha
- Madison
- Waupaca

WYOMING
- Cheyenne

CANADA
- Coleman, Alberta
- Edmundston, N. B.
- Montreal, P. Q. (2)
- Moose Jaw, Sask.
- Ninette, Manitoba
- Penticton, B. C.
- Three Rivers, P. Q.
- Vancouver, B. C.
- Victoria, B. C.

PHILIPPINES
- Manila

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

GUILD CLUBS PLAN FALL PROGRAMS

Official Magazine
POPULAR SCIENCE MONTHLY

REPORTS from home workshop clubs throughout the country show unmistakably that the coming season will be the most successful in the history of the National Homeworkshop Guild. Many special features are being planned by the clubs, and all expect to increase their membership rolls.

Wichita (Kans.) Homecraft and Hobby Club. By transferring an exhibit of members' work from one section of the city to another, considerable interest has been aroused and new members obtained. The display was first shown in a clothing store on the north side of town and, after circling other outlying stores, was gradually moved closer to the heart of the city, arriving in the downtown section in time for Railroad Week, when it was divided among an art and homecraft store and several transportation companies, which used the exhibits pertaining to transportation. The exhibit includes many models of airplanes, boats, and trains; a miniature optical shop showing complete lens-grinding equipment in operation; jig-sawed art plaques in relief of scenes in Washington, D. C.; wooden chains whittled from solid pieces, an inlaid glove box, beaded belts and leather work, fountain-pen paint sprayers for model work, a turned hanging flower bowl, and turned dresser bowls. Meetings were discontinued during the summer, but the exhibit was carried on. Local newspapers have cooperated in the work.

Club des Artisans Amateurs, Trois Rivieres, P.Q., Canada. Approximately 4,000 persons viewed the club's first annual exhibition in the windows of a local hardware store. There were fifty-three pieces of craftwork in the exhibition, which was not competitive. Among the more interesting projects were a 32-in. yacht and a carriage by Edmond Boisvert; three pieces of wood carving by L. P. Bélangér; a violin by Albert Chartier; and a whittled sea captain by C. B. Meyers. A great deal of fretwork was displayed. The club plans to hold a competitive exhibition later when the members are more experienced and the total enrollment is larger.

Orchard Park Home Work Club, West Lynn, Mass. Organized with six senior and six junior members, this new club plans an active vocational guidance program. Donald William Fraser is supervisor of activities.

Creston (Iowa) Homeworkshop Club. C. N. Scott lectured on pattern making and molding. He poured aluminum for a cylinder and showed how to finish it on a metal-working lathe. The meeting was held in the manual training room of the local high school. . . . One session was held at Spring Lake, Corning, and members' wives were invited. A demonstration was given on the different processes in making pottery from the raw shale to the finished product, including turning, trimming, baking, and glazing.

Mansfield (Mo.) Homeworkshop Club. Three members are building cedar chests, one is making furniture for his home, and another is constructing flower boxes.

Denver (Colo.) Homeworkshop Club. A display in a downtown store window caused so much favorable comment that the club was requested to put on a three-day exhibition of craftwork in connection with a Y.M.C.A. circus. The club meets at the Y.M.C.A. on the second Friday of each month except during the summer (Continued on page 103)

GUILD CLUB PROGRAMS

(Continued from page 102)

There is no community shop, but machinery houses have cooperated by lending any type of equipment needed for demonstrations at the meetings. Recent lectures have dealt with the circular saw, shaper, drill press, alabaster, blueprints, metal spinning, leather work, and finishing wood.

Los Angeles (Calif.) Union Railroad. A regional convention of the National Model Railway Association will be held in Los Angeles in November. It is sponsored by the local organization and is open to model railway men in all scales, from H.O. to ½ in., and also to those who do not build to scale or operate "tin-plate" equipment. Persons outside of the city who intend to come are requested to send a post card to W.S.Hofford, 451 S. Clela Avenue, Los Angeles, in order that adequate arrangements can be made. Technical papers will be read and models exhibited.

Col. W. H. Waldron Homeworkshop Club, Missouri Branch, W. Va. Plans were made recently to outfit a new workshop and clubroom. A new tool cage is now under construction. An efficient method of checking out tools was discussed, and bulletin boards were installed. The club plans to purchase a large glass show case. The members will display their work, including woodwork, leathercraft, archery, and square knotting, at the Mountain State Forest Festival, Elkins, W. Va.

Fairmont (W.Va.) Homecraft Club. The making of blueprints is the latest undertaking started by the club. The club constructed its own blueprint frame.

Edmundston (N.B., Canada) Hobbyists. A contest was held recently in which each member was required to build a bird house of any shape or size. The finished models were exhibited in a local store window and an invitation was offered to the public to vote for the best.

Covington (Ky.) Homeworkshop Guild. Joseph Hackman was recently elected president; Henry Stark, vice president; Harrie W. Johnson, secretary; Charles Zimmer, Jr., treasurer and librarian. The board of directors consists of Marshall Herst, C. W. Peters, E. S. Schonk, and Carl Knoeckelman.

Cartier Homeworkshop Club, Montreal, P. Q., Canada. Correspondence is being carried on with several other National Guild clubs to exchange ideas. The following projects are being undertaken by members: 20-in. model of the *Normandie,* Georges Frenette; 12-in. model of an Atlantic locomotive, Jean Tremblay; roller-skate scooter for children, Roger Frenette; hand-powered jig saw and sanding machine, Paul Denis. The secretary, Mr. Denis, recently gave a talk on how to build a model of the *Normandie.*

Kenosha (Wisc.) Homeworkshop Club. Bruno Strecker has been named librarian

Mason City (Iowa) Homeworkshop Club. Organized a year ago, the club now has a membership of thirty-seven. The officers are Max Boyd, president; R. D. Mettler, vice president; John R. Conaway, secretary; Mack Haney, treasurer.

Timpanogus Homeworkshop Club, Provo, Utah. Officers are Dr. Albert R. Taylor, president; Dr. Milton Marshall, vice president; Ramona F. Cottam, secretary.

Fall River (Mass.) Homecraft Club. The first annual exhibition was held recently and the displays judged as follows: first, Clifford Schlemmer, modern end table with inlay; second, George Legault, mahogany end table with glass top; third, Napoleon Goulet, combination bootery and seat; honorable mention, Albert Boutin, twin end tables, and Bernadin Lafond, cathedral wall bracket and colonial corner cupboard. The judges were Frederick Rundall, director, Deman Vocational School; Charles H. Malte, *(Continued on page 104)*

GUILD CLUB PROGRAMS

(Continued from page 103)

instructor, Henry Lord Junior High School, and Charles F. Brown, instructor, J. M. Morton Junior High School. Mr. Rundall spoke to the club on "Adhering to Specific Plans Once a Project Is Started."

West St. Louis Homeworkshop Club, St. Louis, Mo. This club recently reorganized and elected William Callaway, president; Harry Van Dyne, vice president; Kenneth R. Fix, secretary and librarian; William Wocet, treasurer.

Maumee Valley Homeworkshop Guild, Maumee, Ohio. Winferd R. Wittenmyer is president of this new club; Alvin Kledzik, vice president; Robert Wittenmyer, secretary; Richard Marsh, treasurer.

Mound Builders Homeworkshop Club, Newark, Ohio. Under the direction of Louis Lee, an authority on finishing furniture, the members have carried on a program of finishing new work and refinishing antiques. A tool of some sort is awarded at each meeting to maintain interest. Meetings were discontinued for the summer, but an active season is planned for the fall.

Tri-City Homeworkshop Club, La Salle, Peru, and Oglesby, Ill. A demonstration on how to coil a band-saw blade and how to braze a broken blade was given by Joseph C Ruscinske at a recent meeting at his home. Meetings will be resumed on September 15 when R. F. Lindenmeyer, president of the club and instructor of manual arts at the La Salle-Peru High School, will demonstrate wood turning.

Winfield (Kans.) Homeworkshop Club. Glues and gluing problems, the use of turning tools, and methods of antiquing wood were discussed at a recent meeting in a local hardware store. Three new members were admitted.

Waupaca (Wisc.) Homeworkshop Club. George Klake won the contest sponsored by the club for the best article made at a cost not exceeding $2.50. The entries were displayed in a local hardware store window. The club has visited a boat factory and a blacksmith shop. Meetings were discontinued during the summer but will be resumed September 3. Officers are Marlyn Looker, president; Severt Neilson, secretary, and Basil Barnhart, treasurer.

Brunswick (Me.) Homeworkshop Club. The second annual dinner was held recently at Jaquish Inn. Gerald Russel was in charge of tickets, W. A. Duquette took care of transportation, and Steve Merrill entertained.

Spokane (Wash.) Homecrafters. William E. Mitchell, a member of this club, has been elected president of the American Society of Inlay Artists, an organization recently organized to "promote an active interest in intarsiatura, to increase the knowledge of its members by the interchanges of ideas, to attain a high degree of artistic workmanship and ability, and to interest others in the art." All the officers and governors are active in the home workshop movement, particularly the educational side. An exhibit will be held in San Francisco later.

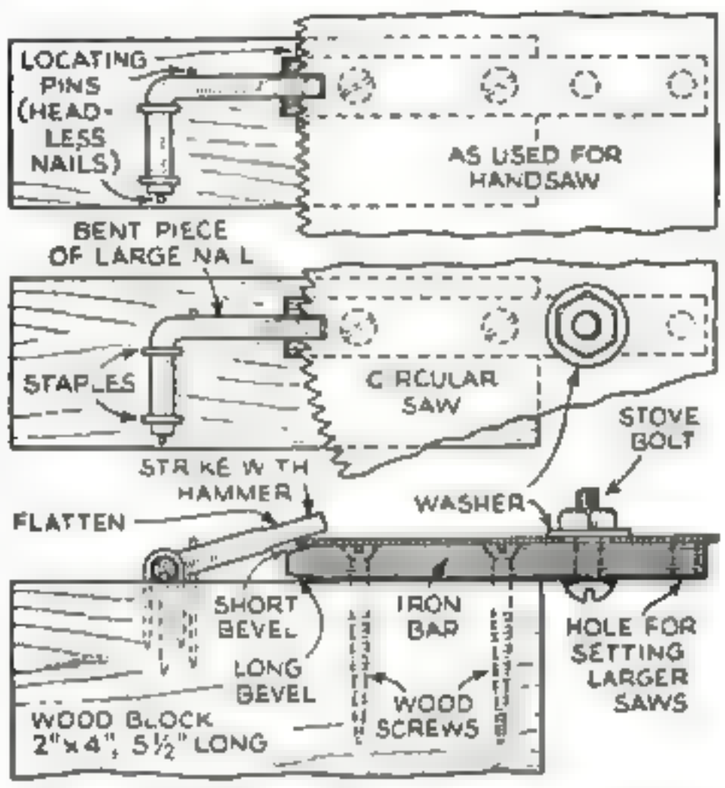
Dover (N. H.) Homecraft Club. Having attained a membership of fifty-nine in its first year, this club plans an active program for the new season. The fall schedule began with an outing the latter part of August at the camp of Wallace Varney, former president. On the committee were Arthur Cram, Sr., L. J. Batchelder, and Daniel Flint. . . . Representatives of many manufacturing concerns as well as members have given talks on various phases of the home workshop during the past year.

Queen City Craftsman Club, Cincinnati, Ohio. James Theis is president; Oscar R. New, vice president; John Westermann, secretary and treasurer. There are eight charter members.

SAW TEETH QUICKLY SET WITH SIMPLE DEVICE

FOR giving a uniform set to the teeth of circular and other saws at the time they are filed, a surprisingly simple fixture can be made as shown below from a few scraps of wood and iron. With it, the unpracticed hand can do a good job of setting, and do it more rapidly than with some of the more commonly used setting tools. The device is gripped in a bench vise while being used.

A piece of 2 by 4-in. block, 5 in. or more in length, will be suitable for mounting the metal parts. These will include a piece of flat or square iron bar, ⅜ by ½ in. or more in size, and 1 in. longer than half the diameter of the largest circular saw to be accommodated; a short stove bolt with nut; one washer slightly thicker than the circular saw and of an outside



Top and side views of the fixture, which enables saws to be set speedily and accurately

diameter to fit snugly inside the hole in the saw; another of larger outside diameter; and a large nail or spike.

With a file, bevel off the end of the flat bar to the angle desired for setting—usually from 10 to 15 deg. Hold the circular saw against the bar in the position shown, with base of teeth at top of bevel, and scribe a circle inside the saw hole. In the center of this circle, drill a hole through the iron bar to receive the stove bolt, not too loosely.

A piece of the large nail, filed slightly flat at one end, bent to a right angle and attached with staples and nails as shown, rests upon the saw tooth and, when struck with a hammer, quickly bends each tooth in turn to the angle of the bevel on the iron bar. For use in setting handsaws or band saws, two additional locating pins may be driven into the wood block as indicated in the upper sketch.

Each time the same circular saw is filed, the bevel on the flat bar may be filed slightly, to adjust it to the shortened radius of the saw. Fifty teeth or more a minute can be given a smooth, uniform set in this way. Ripsaws will require a longer bevel and therefore a different flat bar. If, however, the bar stock is stiff enough (not less than ⅜ in. in thickness), one side can be beveled for rip and the other for crosscut teeth. Reversing is then accomplished by removing the two wood screws.—H. K. RANDALL.

• • •

Keep a sponge rubber kneeling pad on the workbench for holding screws and small metal parts, so that they can be picked up easily.—K. L. ROBBINS.

• • •

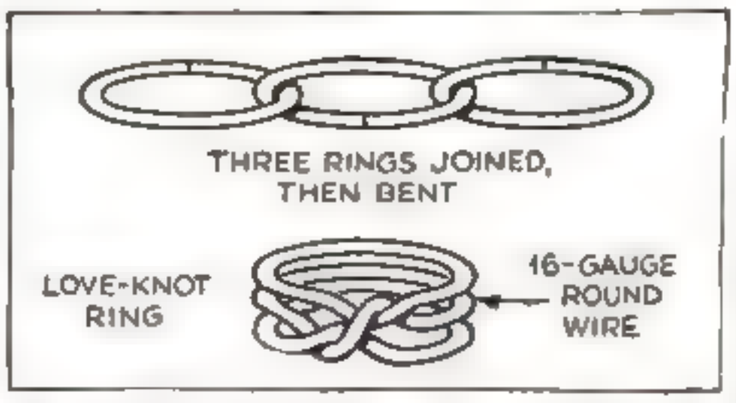
AN ORDINARY harness snap in the hasp of your fishing tackle box will enable you to carry it by the handle without the bother of locking and unlocking it each time it is to be moved.—PAT MACDONALD.

HOW TO MAKE JEWELRY

(Continued from page 77)

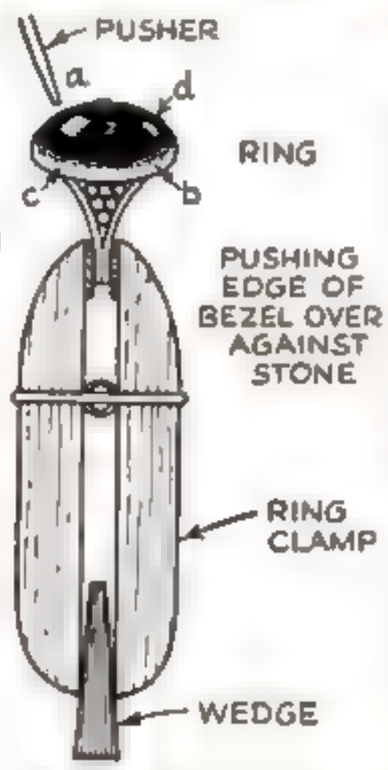
The support for the stone is made from a thin strip of sheet silver or a piece of round wire and is soldered inside the bezel. In the case of a box bezel, however, no stone support is needed, as in the thunderbird ring, unless it is desired to raise the stone, when a support may be inserted, as illustrated in one of the drawings.

Before putting in the stone support, it is well to see that the bezel is exactly the required size, as it can easily be stretched, if too small, by hammering it lightly on a tapering mandrel.



To form a love-knot ring, three circles of wire are joined and bent so as to interlock

If the bezel is made of twisted, hammered wire, anneal the strip after hammering by heating to a red heat. This will prevent it from breaking when being bent.



How edge of bezel is bent to clasp stone

When leaves are used to hold the stone in place, the bezel is made very low.

Finger bands. The finger bands are made from 16-gauge round sterling wire. There are two types, either of which may be used.

Two pieces of wire are heated to anneal them, straightened, placed alongside each other, and if necessary bound with binding wire. In one type, the wires are soldered together near the middle; in the other type, they are soldered near the ends.

In the second type, after the ends are soldered, the band is bent to the general shape of a ring. The unsoldered portion—the center—is spread apart and the bezel inserted. Place the parts on a charcoal block and solder both wires to the bezel at the same time.

The way to cut silver solder into tiny bits

If the bezel projects below wires, as shown at *F* in the sketches, file out that portion.

After the bezel is soldered in place, shape and cut the ring band to the required size. Bind with wire and join with silver solder.

The first type of band is used on the monogram, souvenir coin, and thunderbird rings, and occasionally it is desirable to use it with stone rings. In fitting this kind of band, see that all four "feet" touch the bezel, and solder all four at the same time

Ornaments. Many ornaments suitable for this type of jewelry may be made from wire or sheet silver, or may be purchased already stamped out.

Take a length of *(Continued on page 107)*

HOW TO MAKE JEWELRY

(Continued from page 106)

wire and twist it around a mandrel of some kind, thus forming a coil of wire. With snips, cut the coil into circles, thus forming equal lengths of wire. By melting these separately on a charcoal block, it is easy to form small shot, which may be used singly, in units, or in clusters.

If desired, small disks may be made from the shot by flattening them. Leaves, buds, grape bunches, flowers, and other ornaments may be made from the flattened shot, after annealing them, or from 26-gauge sterling sheet.

In making leaves, buds, and the like, the veins are cut in with a dull chisel made from a nail set, the silver being placed on a lead block or the end grain of hardwood. Then cut the ornaments to shape and by using a punch, ground to a ball shape on the end, slightly dome the metal. A variety of designs are shown on page 77.

Different size wires may be twisted and bent in various ways to form a number of ornaments. It is easy to obtain unique effects by using twists and combinations of twists.

Pickling. After a joint has been silver soldered, it is generally unsightly because of the glazing of the borax. This glaze is removed by dipping the work in a pickling solution made of one part of sulphuric acid and fifteen parts water. (In mixing, add the acid to the water; to add the water to the acid is dangerous.) The solution may be used cold, although it works better if warm. Keep the pickle in a copper, glass, or earthen vessel. Use a copper or silver wire in retrieving articles from the pickle.

Symbolic Indian design — a thunderbird

Coloring. A ring may be oxidized by dipping (before the stone is mounted) in a hot solution made by dropping a lump of potassium sulphide (liver of sulphur) in a glass of boiling water. The metal must be buffed and thoroughly cleaned before oxidizing. Use a weak solution for oxidizing, because if it is too strong, the color will rub off very easily.

After removing the ring from the solution, dry thoroughly and sprinkle with a little powdered pumice or some kitchen-cleansing powder and rub with the finger until you get the desired shade of gray. It is desirable in many instances to remove all the coloring from the high places.

Stone setting. After the ring has been oxidized, the stone may be set. Place the stone in the bezel and push the edge of the bezel over toward the stone, working at opposite points (*a,b,c,d* in the stone-setting sketch). By using a burnisher, the irregularities left from the setting can be smoothed out. The silver, being quite soft, bends easily, but in the course of the bending and crimping, it hardens and will then stay in place.

BARNEGAT LIGHTHOUSE

(Continued from page 69)

the wood, bore a ¼-in. deep hole to fit the lantern.

Take the lamp socket and break or cut away the outside so that you have only the metal left. Bend down the contact lugs so that they will extend horizontally as little as possible. Bore a hole down into the tower to form a loose fit for the socket, and chisel out slots on either side to take the lugs. The socket should set in a depth to bring the bright part of the lamp about the middle of the lantern. Bore a ⅜-in. hole through the remainder of the tower.

INDICATE the oblong windows, as well as a door at the back of the tower, leading to the sand, and another door leading onto the platform below the light. I made shallow cuts for these, painted the doors brown, and rubbed in some blue color and clear cement to represent glass in the windows.

At the height shown, provide six projecting beams to support the lower platform. Both platforms are made of sheet metal. The rail stanchions are pieces of No. 20 brass wire set in holes and soldered underneath. The top-rails are pieces of wire flattened and soldered onto the ends of the stanchions. I gave the lower platform an additional intermediate rail of thin wire. The top platform neatly fits on the lantern, and the lower one slips over the tower and rests on the beams.

The sand dune is a piece of 1 by 4⅜ by 8⅛-in. pine carved to shape. It curves down to nothing at the front to represent the shore, and is steep at the back. The surface is wavy to represent drifting sand. This carved piece is glued to a ½-in. thick baseboard, 5 by 8¾ in. A ⅜-in. hole is bored vertically through both to meet the hole in the tower, and another is bored longitudinally to meet it from the end or back

The lower half of the tower is white; the upper part red, somewhat weather beaten. The lantern and platforms are black. The opaque part of the lantern, at the back, is white.

To assemble, glue and screw the tower to the carved block, with the holes coinciding and the door at the back. Cut and glue on a small set of steps to lead to the door. Glue the block to the base. Connect the lamp cord to the socket very firmly, and insulate the whole socket with rubber and friction tape. Thread the lamp cord through the tower and base, and draw the socket down into position. Screw the lamp into the socket and set the lantern and platforms in place.

I made the trees from pieces of real trees, trimmed to shape and dipped in clear lacquer to preserve them. They are, however, somewhat fragile. Neat little trees can be made from lamp cord by stripping off the insulation, teasing out the strands, and twisting short lengths together to form the trunks. These would have to be painted in natural colors. Set the trees in holes to give a wind-blown effect. Stain and varnish the base. Coat the carved block with casein glue and press sand into this.

IF A correctly flashing effect is desired instead of a fixed light, it will be necessary to use batteries or a 6-8 volt doorbell transformer and a low-voltage lamp in the tower, with a clockwork movement to time the flashes.

Obtain an inexpensive electric clock with a large second hand. Take off all the hands and cut a piece of thin plywood, fiber board, or some such insulating material to fit over the dial, and cut out the center as shown in one of the photographs. To the piece thus made, fasten a ring of copper wire with one end extending. I did this by lacing the ring in place with fine wire, and then glued a thick piece of paper on the back *(Continued on page 109)*

BARNEGAT LIGHTHOUSE

(Continued from page 108)

of the plywood. Clip this under the clock rim, or cement it to the face. Insulate the extending end of the copper wire and pass it through a hole or over the edge to the back of the clock.

Barnegat Light flashes every ten seconds, so at points representing ten-second intervals put large drops of solder on the copper wire. File them smooth to an even height and to a length equalling a one-second division. Have the left-hand ends slope to make an easy approach for the second hand. Give the second hand a twist so that its leading edge is higher than the other edge. Then replace it firmly.

To connect with the current (which must be alternating) take one pair of wires directly from the light outlet to the clock movement.

The flashing mechanism is an electric clock with contacts spaced at ten-second intervals

To each of these wires splice pieces of wire to lead to the power side of the transformer. From the low-voltage side of the transformer run one wire to the extension from the contact ring on the face of the clock. One of the two wires from the lantern is then fastened to the clock frame at any convenient point, and the other goes directly to the other low-voltage binding post of the transformer. All joints should be soldered and insulated.

When the second hand of the clock is in contact with one of the lumps of solder, the current flows from the transformer through the copper wire, through the second hand to the clock frame, from there to the lamp, and then back to the transformer.

My clock is rather large so I made it a separate unit in a box to stand on the floor, but it could be built into a large base for the lighthouse.

A 6-8 volt automobile tail or brake light is the best kind of lamp. (Headlights have too large a diameter.) This kind of lamp will need a different method of placing in the tower to bring the bright part of the bulb about the middle height of the lantern. Since the lamp is of the bayonet type, file off the side lugs. Bore a hole in the tower about ½ in. deep to fit the metal base of the lamp tightly. Make two disks of fiber, hard rubber, or other insulating material of the same diameter. Bore a hole in the center of one, large enough to admit the whole center contact of the lamp; and in the side of both, drill a hole just large enough to take one of the connecting wires. In the center of the second washer drill a similar small hole. Pass one wire up through this center hole, and the other through both side holes. Put large drops of solder on each end of the wires and draw them down tight. Insulate both wires underneath so that there is no contact between them anywhere. *(Continued on page 110)*

Old Bill SAYS:

YOU can obtain a frosted surface on brass by the following method: suspend the parts in a boiling solution of caustic potash for a few minutes, rinse in clear water, and dip in nitric acid until all oxide is removed; then dry in warm sawdust, and lacquer while warm.

* * *

When chatter marks are left by old-type cylindrical grinders, look for worn centers, wheel out of balance or poorly dressed, and belts that slip or have defective lacing.

* * *

Before using a high-speed drill without a lubricant, immerse it in hot water for a minute or so. Never flow cold lubricant on a heated drill.

* * *

Whenever possible, belts running at high speed should be made "endless" by lapping and cementing the ends. Such belts will run truer and last longer.

* * *

To polish a plug or ring gage after lapping, without affecting its size, use crocus cloth.

* * *

Three-lip drills are rapidly replacing rose reamers in up-to-date machine shops. When correctly sharpened, the drills are just as accurate and give greater production.

BARNEGAT LIGHTHOUSE

(Continued from page 109)

Draw the disks and wires to the bottom of the hole and press the lamp in, to make the contacts engage the center and side of the lamp base.

A simpler but less accurate method is to use a flashing auto brake bulb. This gives a quick flash which one cannot regulate. Installing one would be as just described except that the height might need some adjustment. Outlet flashers may also be had for 110-volt current, but they will not work with less than a 40-watt lamp, so to use one a lamp of that size would have to be put in series with the lighthouse lamp. They also give a quick flash. With neither type of flashing device would one need any clockwork.

Either of the auto lamps mentioned will, of course, work with dry or storage batteries.

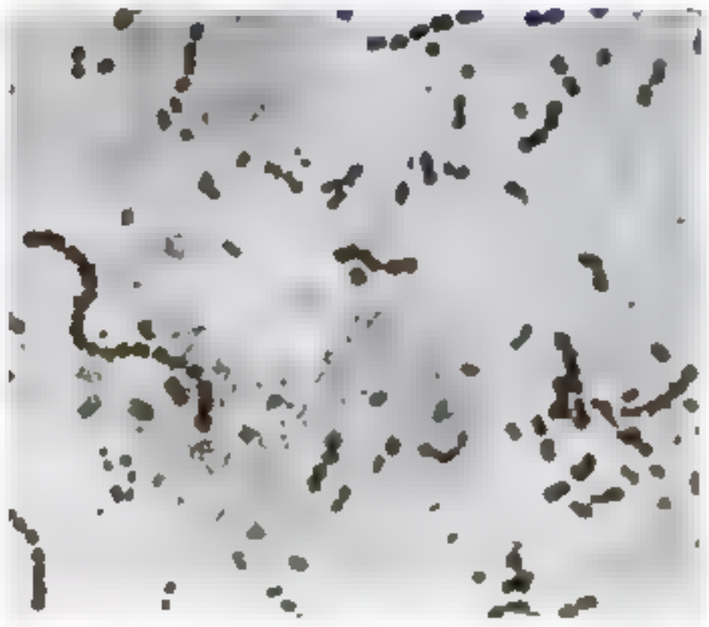
A smaller lighthouse could be made by using a small surgical lamp.

To make other lighthouses than Barnegat it would be necessary to know the appearance of the tower and its surroundings and the periodicity of the light. On charts "F." stands for fixed; "Fl." for flashing, or short light and long dark; "Occ." means occulting, which is long light and short dark; and "Rev." is revolving, in which the beam of light swings around the whole or part of the horizon. The latter are now quite rare. Any flash or "occult" can be arranged by suitable arrangement of the contact knobs on the clock wire.

A lighthouse like this consorts well with a group of ship models. Standing on the window ledge facing outwards, it makes an attractive "welcome light."

ANSWERS TO COMMON MICROSCOPE PROBLEMS

(Continued from page 49)



Bacteria in buttermilk, stained with Loeffler's solution and magnified to 1,500 diameters

power of the lens becomes greater; that is, greater detail can be seen without increasing magnification. Also, the image becomes much brighter. The most common way of doing this is to place a material such as thickened cedar oil between lens and cover glass. The refractive index of this oil is the same as that of the glass used, so some of the rays of light, in traveling from a point in the object to the lens, are not refracted or bent outward so as to miss the objective, as they do when passing from the glass slide to air. Although cedar oil is the common immersion liquid, water and other liquids can be employed with lenses designed for them. The amateur should not worry very much if he has no oil-immersion objective, for he can do most of his observing with lower-powered, less costly lenses.

When an amateur buys a microscope costing not more than twenty dollars, which is more important, clearness of image or magnifying power?

CLEARNESS of image should be preferred always to high magnifying power, for the simple reason that a magnification of, say, 500 diameters is of little use if the image is so indistinct that the details cannot be seen. Size alone is not sufficient; the image must be reasonably sharp. The trouble with a great many microscopes offered for sale to amateurs is that their lowest magnifications are too high. A great many common objects, such as the eggs of insects, are seen better at a relatively low magnification of twenty or thirty diameters, than at 100 or more diameters. It has been said that perhaps seventy-five percent of all amateur observation can be done at magnifications of 100 diameters or less. Inexpensive microscopes, because of inherent faults in their lenses, produce less distinct images at high powers than at lower magnifications.

Can carbon tetrachloride be used for dehydrating specimens, instead of several baths of alcohol?

NO. CARBON tetrachloride does not enter into solution with water, and therefore cannot be used for extracting water from a specimen. Grain alcohol in various concentrations is employed almost universally for dehydrating. Water in the specimen enters into solution with the alcohol. Two such liquids tend to diffuse evenly through each other. Thus some of the water in, say, a section of plant stem, has to leave the stem when the specimen is placed in alcohol, in order to make this possible.

The routine of dehydrating with alcohol consists of leaving *(Continued on page 112)*

ANSWERS TO COMMON MICROSCOPE PROBLEMS

(Continued from page 111)

the specimen for successive periods in alcohol-water solutions of increasing strength, until finally absolute alcohol (that containing no water) is used. Concentrations and times of immersion vary with the kinds of material and sizes of the pieces. Thus a piece of plant tissue, previously fixed in chrom-acetic acid and washed, is left an hour in fifteen percent alcohol, an hour in twenty-five percent, two hours in thirty-five percent, two hours in fifty percent, and finally placed in seventy percent alcohol, where it can be preserved indefinitely. For complete dehydration, it is placed for an hour or two in eighty percent, ninety-five percent, and, finally, absolute alcohol.

How should a rank beginner go about focusing a microscope?

FOCUSING a microscope is not difficult; it is a simple operation that, once learned, is performed automatically, like lifting your feet when you walk. The greatest danger is that the objective lens will be pushed down against the slide so hard that the cover glass, and, perhaps, even the specimen and the lens, are damaged. The procedure followed by the careful microscopist, particularly for short-focus (high-power) objectives, is as follows: While looking at the side of the objective and the slide or specimen, lower the microscope tube until the objective tip almost touches the cover glass, or surface of the object if it is not mounted. Then, and only then, move your eye so that it is looking into the eyepiece. Now, by slowly moving the tube upward, bring the image into sharp focus. Once the approximate focal position is found, fine focusing can be done by moving the tube carefully in either direction. With larger microscopes, the fine adjustment always is used when focusing very near the cover glass, and when making minute adjustments at any position.

What important stains does the amateur need, and what are the formulas for them?

THE staining solutions required depend to a large extent on the type of work being done. However, for a start, the amateur can get along nicely with less than a half dozen. These might include:

Iodine: Use ordinary tincture of iodine, and dilute with five parts water or alcohol.

Mercurochrome: Use in the strength sold for antiseptic purposes, or dilute with water as required.

Eosin: This produces a red or pink color. Can be purchased as a tablet or powder, and dissolved in water or alcohol.

Methylene blue: This is one of the most useful of stains. Loeffler's solution is made by mixing thirty cubic centimeters of a saturated solution of methylene blue in alcohol, with 100 cubic centimeters of water to which has been added two drops of ten-percent solution of potassium hydroxide. (A teaspoon holds about 3.5 cubic centimeters, an ordinary drinking glass about 240.)

Haematoxylin: Solutions such as the Delafield haematoxylin stain are difficult to prepare properly, and are best purchased ready-mixed. Often used with eosin for staining animal tissue.

Acid fuchsine: Make a one-percent solution of the dry stain in water or alcohol.

Methyl green: Make a saturated solution in distilled water, or in one-percent acetic acid. Methyl green and acid fuchsine are used for double staining of botanical preparations. The specimen first is stained several hours with methyl green, *(Continued on page 113)*

ANSWERS TO COMMON MICROSCOPE PROBLEMS

(Continued from page 112)

washed, and then placed for a few minutes in the acid fuchsine solution.

There are a number of microscope supply houses which carry large assortments of microscope stains put up in one-ounce bottles, or in similarly small quantities. An ounce of almost any stain will last a surprisingly long time.

Can I see bacteria at 400 diameters with a microscope costing less than five dollars?

TO ANSWER this, it would be necessary first to examine the microscope. However, cheap microscopes generally are almost useless when it comes to revealing bacteria. Although the magnifying power may be there, the definition of the image is so poor that the observer does not know whether he is looking at a bacterium or a speck of dust. It is possible to see bacteria with amateur microscopes made by reliable companies and selling for as little as fifteen to thirty dollars, but considerable patience is required. Bacteria should be stained with a preparation such as Loeffler's methylene blue; sometimes the use of a deep yellow or orange color filter will improve the image by increasing contrast.

Can a microscope be used to detect adulterants in ground coffee and other foods?

YES, indeed. The Board of Food and Drug Inspection of the U. S. Department of Agriculture maintains one of the finest microanalytical laboratories in the world, for detecting foreign materials in foods, and for analyzing drugs. To examine ground coffee, moderate power can be used. The coffee is examined without any particular preparation, by strewing some of it on a slide and looking at it. Among the adulterants that have been used are coffee chaff and rye cereal. Coffee sold by reliable companies contains no adulterants.

The microscopist who would detect foreign substances in his coffee or other food should first learn to identify positively the coffee or food itself—learn how it appears under all conditions. Thus the surface of a particle of crushed coffee bean has a characteristic appearance. After a microscopist has learned to identify the food itself, he is fairly certain to recognize adulterants present in any effective quantity.

MEASURES 17,000 NERVES IN HUMAN SPINE

MORE than 17,000 nerve filaments running through the human spine have been measured and classified by a Swedish professor at the Carolinian Institute in Stockholm, Sweden. The scientist cut thin slices of the spinal cord and stained them. These stained slices were magnified 750 times and photographed, revealing that the tiny nerve threads vary in thickness from one-thousandth to twenty-one thousandths of a millimeter.

AUTOMATIC RESTS KEEP MIND FROM TIRING

THE human mind automatically "puts on the brakes" several times each minute, according to recent tests performed at the psychological laboratory of the University of Chicago. These "blocks" are enforced rest periods, and it is believed that they may account for the fact that sustained mental work does not tire the individual as much as sustained physical work. During the "blocks" the individual does not lose track of what is going on.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

MORE $5 PRIZE WINNERS

Two prize winning letters in POPULAR SCIENCE MONTHLY'S new Secrets of Success contest—*"What Home Study Has Meant to Me"*—are printed below. Read these stories carefully because your own career may be just as interesting and inspiring to other readers. If you think so, put it down on paper and send it in. We will pay $5 for every letter we publish.

Contest Rules

Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 750 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

FACTORY HAND NOW COPYWRITER

When I took that course with the—— —— School I never dreamed what an important bearing it would have on my future. I had been making wooden heels for ladies' shoes and the writing course was more of a hobby than anything else. Then out of a clear sky came the crash. The company I was working for failed and the plant closed, stunning the whole community.

A few months later I heard of a machinery concern in Nashua, N. H. which was looking for a man to prepare advertising booklets. I decided to call on them.

How well I remember that day! The general superintendent looked at me. "Can you describe the functions of a machine and are you able to tell in clear, concise language how it operates?" he asked.

I told him I thought I could. But when he asked where I had worked, I told him the truth; that I hadn't worked for anybody as an advertising man. For a minute that seemed to end the interview.

"No," said the superintendent, "you won't do."

Having gone this far, however, I wasn't going to quit without a struggle. I told the superintendent how I had spent the

Secrets of Success

past year studying how to write. I showed him my ——— School diploma. He pondered for many minutes and to me it seemed like ages. Then he said:

"I'll give you a trial. But, I warn you, it will be considerably different than making wooden heels."

I never did learn when that probationary period ended because I am still working for this company. There was a crying need for catalogs and instruction books; somebody had to write magazine advertisements, and the job fell to me.

The course with the ——— School has been valuable to me not alone for what I learned but for the opportunities it presented and which I hope I have been intelligent enough to recognize. I am satisfied that these opportunities would never have arisen if I hadn't taken that course.

No, I am not making big money . . . yet. But I know that some day I will have a much better paying and steadier job than I had making wooden heels. I realize that I am now laying the groundwork for employment that is stable. And I would never have been able to do so if I hadn't shown the general superintendent my diploma from ———.

—*R.C.D., Nashua, N. H.*

KEEP PUSHING YOUR GOAL AHEAD

When I was a boy my father often scolded me for "wasting" time at our old family organ, playing hymns instead of pulling weeds in the small truck garden or otherwise putting in a back-breaking day under the broiling sun of north-central Indiana.

But somehow I just couldn't keep away from that instrument. I was deeply interested in sacred music and as time went on I made up my mind that I was going to be a composer of it. Father, however, wanted me to study art, for in high school I was considered rather good at drawing; in fact he more or less insisted upon it. Finally, when I refused point-blank, he invited me to "go out on your own".

It was a challenge but one which I accepted gladly and a few days later I was in Dayton, Ohio. There I got a job in a factory and took up a home study routine of my own, analyzing what hymns, anthems and other works I had. In 1916, I wrote my first song. Like so many maiden efforts, it died a natural death but I kept on and even after my marriage I still devoted considerable time to my own course. At last, I "hit" the market and I thought I was made. But I was too optimistic, for during the next few years my efforts were rejected.

While on a visit in Detroit, I was told by a professor of music that if I would study the laws of harmony, composition, etc., he felt sure that I would get results with my work, so when I returned home I enrolled with the ——— Conservatory.

Even before finishing my studies, I had so improved that I sold a number of hymns and started doing arranging for others. After twenty-three years of searching, studying and hard work, I began to

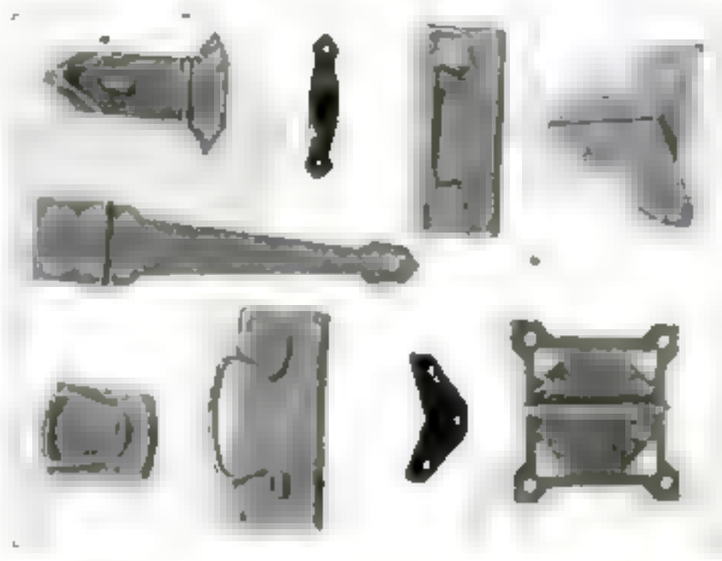
Secrets of Success

reap the rewards for my "stick-to-it-iveness" and now my anthems are being published in New York, Cincinnati and Chicago. In addition, I have, at times, more writing and arranging for others than I can attend to.

Naturally I have a deep feeling for home study, but I realize, too, that one must be prepared to stick to it and set his goal far in the future. Not only that, but keep pushing that goal farther and farther into the future as he nears it. Only by that method can a man say to himself, "I MUST go on!", instead of being satisfied with the first attainment and taste of success.

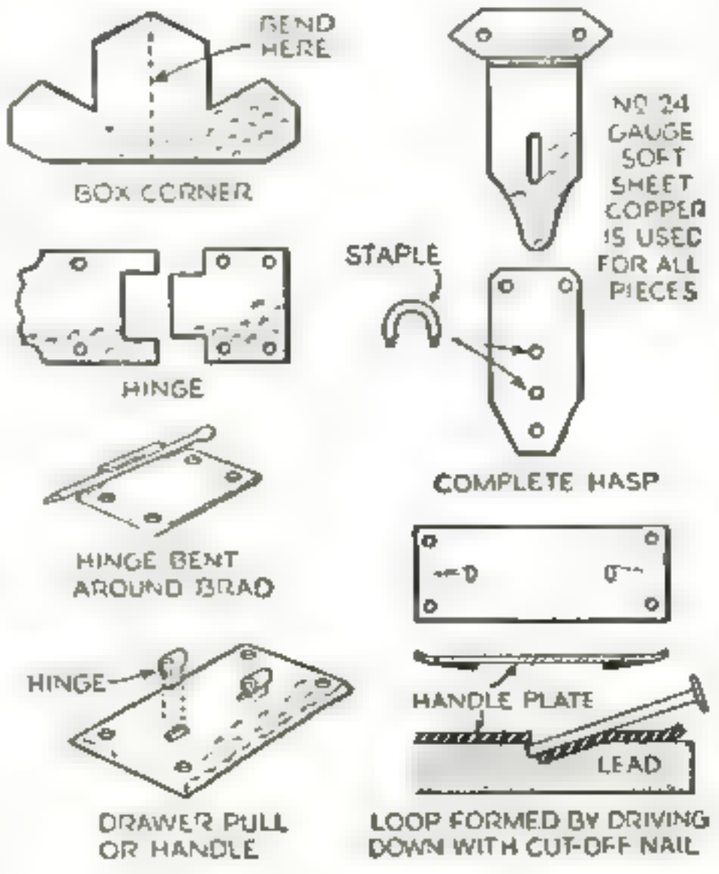
—*R.J.I., Mt. Vernon, Ohio*

HOW TO MAKE HARDWARE FOR SMALL NOVELTIES



COPPER hinges, fittings, and trimmings for small boxes, chests, and novelties are easily made from 24-gauge soft sheet copper. They may be hammered or not, as desired. Several pieces are illustrated, and a great variety of designs may be worked out by using these as a starting point.

The cutting may be done with the tin shears, a cold chisel or a jeweler's saw. Holes are drilled, and the pieces applied with either small roundhead screws or brass escutcheon pins. The wire used for the handles and the staple in the hasp is 10-gauge copper. The hinges shown are bent around a No. 20 wire brad, which is then cut off and headed over to prevent it from slipping out.—DICK HUTCHINSON.



JUNK YARD OF THE AIR

(Continued from page 33)

damaged while flying in China. It was sent to Balboni by a friend across the Pacific. Balboni has a piece of a girder, once a structural member of the dirigible *Shenandoah*, which fell in Ohio in 1925. Lieutenant Funston, an Air Corps pilot, jumped from a disabled plane over San Francisco Bay, and soon after the ship was salvaged Balboni received the engine tachometer. Earl Daugherty, one of the real pioneer airmen of the world, crashed at Long Beach, Calif., in 1926. Balboni got the carburetor from his plane. He has, also, a rib from Captain Nungesser's first steel monoplane, which crashed at New Orleans in 1922. The part reached him through the California Institute of Technology, whose physicists obtained the plane to study structural failures.

IN HIS shop you will find the first Kirkland and Curtiss three-cylinder engine, granddaddy of today's powerful 1,400-horsepower Wright Cyclone. But more than any other relic of a glorious past, Balboni prizes a small square of wood which fell with Quentin Roosevelt behind the German lines during the World War. That, alone, of all his possessions, cannot be bought.

He will buy any wrecked plane, but prefers, when he can, to obtain planes which have carried well-known people. One of his acquisitions is the fuselage and tail—all that remains—of the Gee-Bee racer in which three speed pilots perished while seeking new records.

Jimmie Doolittle used this craft to set a world's land-plane record of 304 miles an hour at Cleveland in 1931. Soon thereafter, Lowell Bayless was killed in the same ship while trying to better Doolittle's mark. The plane was rebuilt, and the next year Russell Boardman fell to his death while taking off from an Indiana field in the course of a New York-California race against time. Again the plane was rebuilt, only to kill the elder of the famous Granville brothers, who had built it originally. For the third time the ship was reconstructed, this time to take the life of Cecil Allen immediately after he had taken off from a southern California airport in an effort to set a nonstop flight record to New York. Then Balboni entered the picture. He paid one dollar for the fuselage and tail, only enough for a legal transfer of title. And now, for the fourth time, another pilot plans to whip the craft into shape again, install a powerful engine, and try for more records. Meanwhile, the junkman has sold sixty dollars' worth of parts from the cockpit, including the belt and throttle, and has permitted four visitors to sign their names on the rudder for twenty-five cents each.

Balboni started in 1928 what he calls his "Gold Book." It is not gold, but simply a large black-bound ledger. In it, 13,000 persons have signed their names, residences, telephone numbers (regardless of where they live), and the date, all with Balboni's fountain pen. Why "Gold Book?" Because Balboni places a large gold cross after the name of each visitor who has died. To date, 185 crosses note the ends of brave fliers.

I READ there the signatures of Col. William Mitchell, who stormed his way through a long career in aviation; Loren W. Mendel, once co-holder of the world's endurance record; Roy Wilson, who died while stunting an ancient, rebuilt Curtiss pusher; "Spud" Manning, who set records of long free-falls before opening his parachute, only to disappear over Lake Michigan in an autogiro; C. W. Gilpin, who failed to ride out a storm near Mexico City; and John Montijo, who taught Amelia Earhart to fly, and later slipped during a take-off in Colorado.

UNDERGROUND FORTRESSES GUARD FRANCE FROM INVASION

(Continued from page 15)

the outermost, sensitive tentacles are earthworks of the familiar type, backed by trenches of concrete, and small, turret-shaped machine-gun pill boxes. Held by infantry and screened by a curtain of artillery fire, these may resist attack by enemy infantry. But then, amid clouds of smoke and dust, up come roaring new-type tanks—fast, nimble, and crushing. In their tracks, the attacking infantry follows triumphantly.

SUDDENLY, shouts of dismay arise. One tank after another comes to a stop, blocked by rows of steel rails set firmly in the ground with their sharpened ends protruding. Rushing on, the infantry must enter a deeper inferno. They must ascend a steep, bare slope, swept by machine guns firing from a checkerboard pattern woven in years of expert study, so that each gun protects its neighbors. This death trap is set with belts of barbed wire at intervals permitting a diabolical series of artillery barrages, falling with clockwork precision upon the infantry trying to break through them. The farther the struggling, gasping attack progresses, the more intense becomes this barrage, while, simultaneously, the areas in the rear of the shock troops are blasted by heavier shells fired at longer ranges.

Thousands of cannon, of every caliber from seventy-five to 400 millimeters, are flaming from the parapets of the Great Wall of France, yet the invaders can see none of them. They can barely see their winking flashes, stabbing from amid trees or behind knolls. The long slope is dotted with figures in gray; many lie motionless; others limp painfully rearward, but some still crawl bravely toward the higher ground. Now they see that every knoll, every smallest rise, must conceal cannon that rain shells—both high-explosive and gas—upon them. And the fire of these cannon, too, forms a pattern, into whose entangling meshes the attackers thrust their heads.

SHELLS from the invaders' artillery burst near the flashing guns, but apparently with little effect. Yet, with splendid, disciplined persistence, some attacking groups reach the last barbed wire. Amid its clutching, tearing coils they struggle. They seem about to win through to the last open stretch before the guns.

Then, suddenly, an army has sprung from the ground across their path! The slope, bare a moment before, now swarms with blue-clad soldiers. With rehearsed precision, they hurl themselves upon the trapped men in gray. Grenades crash, rifles crack, bayonets flash in fierce struggle. Back and forth the conflict sways, but always more men in blue appear, as from the earth, at unexpected places. Down to earth are beaten the men in gray; the attack is repulsed.

An imaginative picture, of course, but based upon known facts, and the belief of those who know the technical perfection of this "Maginot Line," named for a French minister of war, now dead. The ambition of his life was to build a line of defense secure against every device of attacking artillery, infantry, tanks, and aviation. Not even bombs from the sky, the French claim, can silence its guns—and bombs would be few, since hostile airplanes would have to pass through the tightest antiaircraft defense ever devised, using remarkable new quick-firing guns whose sensitive-fused shells are directed by automatic eyes and ears. But suppose that even these were not enough to stop the enemy airmen.

Suppose the invaders send a great air squadron. Its losses are terrific, but some get through, bomb and machine-gun the anti-aircraft defenses, and beat off the French airplanes. Hurriedly they clear a spot above one of the firing French cannon. Into that spot fly a few heavy bombing planes. But these carry no bombs. Down from them float parachutes—a dozen, a score! And dangling from the parachutes are men, the newest type of soldiers.

All are young athletes. They wear an outer costume of leather; underneath, light bullet-proof vests. All have light helmets and gas masks. Some carry machine guns, bombs, and pistols; others, the sections of thirty-seven-millimeter cannon and small armor-piercing shells. Here is the modern Suicide Club—the army that drops from the sky, specially trained to scale the Great Wall

THEY climb it by climbing down into it. Aviators have been rehearsed in dropping men to try to silence one of the flaming cannon, and force entrance to the casemate beneath it.

But, as they land, in their ears is the dread sound of machine guns planted all about the gun turret to protect it from just such a threat. The thin ranks of the parachute jumpers become thinner yet, before a devoted, lucky handful manage to crawl like Indians under or around the gun. Wearing rubber gloves, they struggle over electrically charged cables strung to protect it. A signal, and the attackers' machine guns stop. A bomb is placed near the projecting muzzle of the cannon. Its rending explosion throws fragments of the gun in air. A second bomb, and a third, tear cracks in the casemate.

Into it leap the few surviving attackers. Thrusting into the low chamber, they see a gruesome sight. About the shattered gun are contorted blue figures, and another crouches against the farther wall. One hand holds an automatic; the other reaches for an electric switch. Pistols crash. His body sags, but not before his hand has found the switch. A heavy steel trapdoor in the floor clangs shut; a gong rings; the air is filled with a sweetish odor. Gas!

Only two of the attackers survive, and the gas mask of one is bullet-pierced, useless. He sinks to the floor. The second affixes another bomb to the trapdoor. It takes several, but at last, the cover grates slowly back.

A circular staircase, leading downward into invisibility; the dull twinkle of elevator cables and shafts; then pitch darkness. As his eyes become accustomed to the blackness, the invader sees steel shields, and black muzzles pushing through them. He starts to withdraw his head, but he is too late. From below, a brilliant searchlight sears his eyes. Then comes the ripping crash of a big, .50 caliber machine gun, and slowly the trapdoor clangs shut. The underground Great Wall has proven too high for the assault from the sky.

THAT desperate, gallant stroke could hardly have won, even had more attackers penetrated the gun platform, and got through the trapdoor into the shaft leading down hundreds of feet into the earth. For the invader, that shaft is a descent to hell; its dark spiral staircase and elevator shaft, built primarily to rush ammunition up to the cannon, are lined with steel shields for machine guns. And, if attackers should run that gantlet, deep down they would strike another obstacle more solid and formidable. The base of the casemate is a solid blockhouse of steel and concrete protected not only by machine guns but by light cannon, from attack not only from the shaft above, but from the main gallery and lower levels of the labyrinth. Suppose that even one invader, somehow, got through that? *(Continued on page 119)*

UNDERGROUND FORTS GUARD FRENCH FRONTIER

(Continued from page 118)

He would stand on the concrete floor of the main gallery, miles long, whose high roof and sturdy walls are of stone. He would see, at his feet, railroad tracks, running down this main gallery, branching off here and there. If, disguised in French uniform, he ventured further, he would come upon great chambers, dormitories, kitchens, hospitals, for the thousands of blue-clad men he would see everywhere. Their clattering hobnails would be the only sound in those quiet depths, save for carloads of shells rattling along the tracks, through thick steel doors guarded by machine guns, into blockhouses like the one through which he just came. And, through those steel doors, the sighing of elevators, bearing shells upward to the cannon thudding dully in the casemates high above.

THESE shafts are the towers of France's Great Wall. They stand with feet anchored deep in earth by the concrete blockhouses, their heads barely peeping into the open air. From the casemates peer the muzzles of cannon of various calibers, on special mounts. Their eyes are special observation posts on the most commanding ground outside, hidden perhaps in a special casement, a "peasant's hut" of concrete, or a "tree" of steel, where crouch blue-clad men, reporting everything they see, by subterranean telephone cables, to headquarters.

This is the innermost fastness of the whole labyrinth. Here, before a map of the whole system, sit the commanding officer and his staff. To them, by telephone, radio, and buzzer signal, come reports from all parts of their fortress, and from all the other fortresses that, linked together, make the Great Wall of France. From here go the orders for counter-attacks that send troops to the surface to push back attacking bodies that get too close. These may go by tunnels to sally ports hidden in ravines, woods, or villages, at spots tactically important, or they may issue from the main portal of the fort.

This portal connects with a great rearward network of railroads and highways that insure quick movement of reenforcements and supplies up to the Great Wall. The approach to it is a road sunk in the ground. The entrance itself is low, and is guarded on either side by steel-and-concrete turrets, mounting guns. Between them is a great steel door, with an air lock, that connects with a powerful system of ventilators and electric fans. When it is locked, these raise the air pressure within so much above that outside, that it blows out incoming gas. There are also stores of oxygen and gas masks.

The biggest of the subterranean chambers is the munition magazine. It is semicircular, with a narrow-gauge railway running around the great racks on which are piled shells in thousands, high-explosive and gas, grenades, bombs, small-arms ammunition, flares, and barbed wire for entanglements, to be strung at a moment's warning over the peaceful fields above.

THE defenders of the Great Wall are 160,000 picked men of the finest French regiments. They believe in their Great Wall. Daily they rehearse its defense, knowing that in an emergency their numbers would be doubled immediately by eager reserves.

But if, even after such preparation, they should fail, would France be lost? Not yet. Back of the Maginot Line is a succession of cities that are armed camps; Metz, Thionville, Nancy, and Strasbourg; then a second line; Longwy, Verdun, Toul, Epinal, Belfort, and others—all ringed by fortifications that have made history in the past, and may be called upon again to block invasion.

ODD LABORATORY SOLVES SECRETS OF COAL

(Continued from page 35)

inch in width. Under the microscope, however, they are not black, but a beautiful shade of dark red.

Attritus is a sort of vegetable hash, containing all kinds of ancient plant matter deposited during the peat stage in the formation of a coal bed. Less bright than anthraxylon, it appears under the microscope lens as a dull, gray material filling up the space between the bands of dark red.

More revealing than these substances, however, are the traces of spores and pollens that can be detected in these microscope slides of coal.

MILLIONS of years ago, when the coal-producing regions of Pennsylvania, West Virginia, Ohio, and other sections were covered with dense tropical vegetation, all the plant life was of a simple type. The climate was warm and moist, and there were no flowers, no birds, and no specimens of the higher quadrupeds. Plants reproduced themselves not by seeds, but by pollen or by huge quantities of spores like those of the toadstools and ferns of today.

Preserved for æons in the compacted mass of carbon, these spores reveal themselves under the microscope as brilliant yellow particles. Among the most beautiful objects to be seen in a specimen of coal, they are also among the most important, for slowly and carefully, investigators are perfecting reliable methods of identifying coals by their spore content. Already, some twenty-five kinds of spores have been recognized and are being used in classifying coal specimens.

Because coal was formed by compressing the deposits of plant remains into thin layers, spores, originally spherical in shape, are almost always pressed into double-walled pancakes, much like a hollow rubber ball that has been flattened out by standing on it. If you slice a flattened ball at right angles to the top and bottom layers, the ends will appear as elongated loops formed by the edges of the rubber walls. Similarly, spores embedded in coal that has been sliced in this way reveal themselves under the microscope as flattened yellow loops. When the sections are cut parallel to the coal layers, however, the flattened surfaces are seen, and the spores then look like disks.

When present in large quantities, spores have a great influence on the quality of the coal in a bed. They increase its heating value and are rich in tars and oils. The oil content can be visibly demonstrated by means of a micro-furnace, a laboratory device developed by the U.S. Geological Survey. With this apparatus, a coal specimen can be heated while the microscopist watches it through his lens. As the temperature rises, the oil is seen slowly oozing out of the tiny yellow spores.

MORE recently, scientists have been learning how to identify coal through other kinds of plant remains, such as woody cells. The red anthraxylon bands in coal sections often show a very distinct cell structure. By comparing these cells with those seen in microscopic examinations of present-day trees and plants, the coal expert is learning a great deal about prehistoric vegetation. Eventually, Dr. Thiessen believes, the woody-cell remains may become as important as spores in the identification of coal.

Along with plant spores and woody cells the microscope of the coal scientist sometimes reveals fossilized pollen grains, leaf fragments, and occasionally seeds. Most ancient coal-forming plants, however, were much too primitive to form seeds.

Dr. Thiessen's work is not confined to the study of how coal *(Continued on page 121)*

ODD LABORATORY SOLVES SECRETS OF COAL

(Continued from page 120)

was formed in the dim and remote ages of the past, for the process is still going on in the peat bogs of the present day. In many parts of the United States and other countries, there are swamps where trees and smaller plants are going through the ancient process of death, decay, and compression. These peat bogs are a fertile field for scientific exploration.

With his microscope, Dr. Thiessen explores a peat bed from top to bottom. A vertical column of peat, perhaps twenty inches square, is cut from a bed and shipped to the laboratory in Pittsburgh. Before the actual microscopic examination of the various peat layers, the material is analyzed chemically to reveal the action of the forces causing its decomposition. This involves a careful study of the bacteria, fungi, burrowing insects, and other lower forms of life responsible for the gradual decay of the mass of plant material.

ALTHOUGH there have been reports of the finding of insect remains and of bacteria in coal beds, the discovery of a fossilized bug or bacterium is an event yet to be experienced in the Pittsburgh laboratory. Some investigators have claimed that they have discovered living bacteria in coal, but Dr. Thiessen has not succeeded in finding even a dead germ. In the peat beds that will form the coal deposits of a future time, however, bacteria are present in huge quantities.

For purposes of scientific study, these bacteria are grown in the laboratory on sawdust, shavings, or cellulose. Kept in bottles and flasks, they are provided with nitrogen and other mineral culture solutions necessary for their growth. Peat bacteria have been kept alive in the laboratory for seven years, while their part in the chemistry of decay was being studied and analyzed.

It is believed that the action of these bacteria is to a large degree responsible for the decay of the woody substances and the formation of humins, one of the principal materials to be found in peat. Just what happens to the bacteria is not clearly known, but it has been suggested by some investigators that these peat bacteria themselves become a part of the very deposit that they have created.

Coal is found only in the form of beds, which may vary from a few inches to many feet in thickness and may range up to hundreds of miles in area. Each bed was formed during a definite period of geological history and therefore contains characteristic types of plant remains which provide the laboratory key to the exact variety of coal to be found there. In some coal regions, such as West Virginia, there may be thirty or more distinct coal beds, separated from one another by seams of shale, sandstone, limestone, or other rock.

GENERAL naked-eye methods of classification, and the more exact method of the microscope, are today enabling producers to sort the products of their mines into the types best adapted for the various coal uses, such as domestic heating, commercial steam production, or the manufacture of illuminating gas, tar, and other by-products.

So the laboratory in Pittsburgh unravels and records the life history of coal, and makes the microscope as important a coal-mining tool as the pick, shovel, or pneumatic drill. When next you are tempted to regard your coal bin with disgust, remember that those dirty chunks of common coal not only conceal hidden beauties, but also contain within themselves the indelible records of biological and geological history for millions of years.

THE WAY WE STAND

(Continued from page 41)

policemen, engineers, salesmen, and plumbers. As few of them do hard manual labor, or work for excessively long hours at clerical tasks, their occupations have but little effect on their postures.

In making the study, the 2,200 boys and men were measured, weighed, and given strength tests. They were photographed, and their postures studied by measuring on these photographs various postural angles, such as the angle the shoulder made with a vertical line, the angle made by the extension of the abdomen beyond the chest or of the chest beyond the abdomen, the angle of the general lean of the body, and so on. Careful note was made of all physical impairments.

"OUR study proved," Dr. Thompson told me, "that there is no uniform type of 'good' posture. Normally healthy people, who are normally developed physically, stand in many different ways. This variation is so great that there really are no fixed types of posture. The most marked characteristic of the data we obtained was the wide variation in this respect between person and person. This variability of posture was as marked among the youngest children we studied as it was among adults.

"Of course, a person who stands up straight looks better than a person who doesn't. On the basis of appearance alone, it is possible to grade peoples' postures as 'good' or 'fair' or 'poor' or 'very poor.' We did that, but we found no relation at all between good or poor posture and good or poor health."

The Health Service surgeons found that age has a profound relation to the way that people stand, but that an individual's type of build, as judged by the relation between his height, weight, and abdominal circumference, had little effect on his posture. They also found that men whose physical development was above the average had, as a class, no better posture than those whose development was below the average.

No relation at all was found between posture and strength. Men who were very strong did not differ particularly in the way they stood from men who were very weak. All strong men did not stand alike, and neither did all weak men.

Of the five men who had the strongest hand grips—200 kilograms, as recorded on a hand dynamometer—four were graded as having only "fair" posture, and the fifth was rated as having "poor." The posture of the man who made the best record in the pulling test was rated as "fair," as was that of the man who performed best in the pushing tests.

In a combined strength test, including push, pull, lift, lung force, and lung fatigue, the best record for men weighing over 150 pounds was made by a group whose posture could be rated as only "fair."

"MUCH has been written and said," concluded Dr. Thompson, "on the relation of good posture and good health, and good posture and physical efficiency. Our study seems to indicate that the importance of posture has been greatly exaggerated."

So it would seem that, after all these years, the gym teachers and the drill sergeants have been wrong! Within the limits of reason, we may stand and sit in the way that is most natural to us, without fear of losing health or physical efficiency.

For the last several years, there has been a growing realization that the average man doesn't have to train like a prize fighter or a mile runner to keep in decent physical condition. Add to that the realization that he doesn't have to stand like a West Pointer to keep healthy, and the world becomes a more comfortable place in which to live!

THE END OF THE WORLD

(Continued from page 53)

crossed the path of the earth (P.S.M., May'36, p.17), missing us by only a scant 1,500,000 miles—a mere nothing, as astronomical distances go.

The approach of this undiscovered, unknown planetoid was not detected, because it came from the direction of the dazzling sun. It was only after its passage outside our orbit that it was discovered, and its path plotted by astronomers.

It is the close approach which the road of this wild planetoid makes to the orbit of the earth that has caused astronomers to speculate a little anxiously about expected return trips in the future. The plane of its orbit slants only about one and a half degrees to the plane of the earth's orbit, which it crosses twice in each revolution.

THIS minor planet's "year," or the period of its revolution around the sun, is equal to two and one half of our years. Where will the earth be in its course at the time of the next return of the erratic midget world? And the next, and the next?

At their close passage last February, the earth and the planetoid were somewhat like two automobiles—one passing along a parkway, the other shooting across it by an overpass bridge.

Astronomers are now wondering whether, at some succeeding passage across the earth's orbit, the safe overpass may possibly become a perilous grade crossing! If it ever does, and the two planets arrive there together, there may be no one left on earth to tell the story. At the least, there would be nation-wide destruction in some part of the world!

The model, made of stiff wire and photographed in two positions, shows how slight a change in the slants of the two orbits might set the stage for earth's greatest catastrophe.

It is even conceivable that the recent close passage of the planetoid above the earth may have already deflected it nearer to the earth's orbit plane. The experiment illustrated, with a magnet and a ball bearing, shows how this deflection might be caused by the earth's strong attraction for the much smaller planetoid.

That huge meteors, or, possibly, minor planets, have struck the earth in the past is shown by the enormous craters left at a few points on the earth's surface. The best-known example is in Arizona, and was produced at an unknown time in the past. Another such collision, caused either by a giant meteor or a small asteroid, occurred during 1909 in Siberia. The impact apparently vaporized the projectile in a great explosion, which blew down and burned a forest of large trees for a distance of fifty miles in every direction!

ALTHOUGH the chances are extremely small that return of the minor planet would coincide exactly with the presence of the earth at one of the points where its path crosses ours, still, the future activities of the unexpected visitor will be keenly watched. Its unseen approach makes us wonder how many more of its kind are running amuck across the solar system. Even now, we may actually be approaching another perilous grade crossing!

SPARK REVEALS ELEMENTS IN BLOOD STREAM

Elements present in the human blood stream in quantities as small as one part in 100,000 are detected by a method recently perfected by Michigan scientists. A 25,000-volt spark jumps across a gap between two electrodes containing samples of the blood being analyzed, and the flash of light is broken up by a spectroscope. By examining the color lines, experts can determine exactly what elements are present in the sample.

DIGGING THE WORLD'S BIGGEST DITCH

(Continued from page 13)

air before it is sucked into the jets of the Diesels, as a guard against sudden sand storms.

When the machine is ready to travel, it literally walks ahead on its own feet. Two gigantic shoes, each weighing some 42,000 pounds, are mounted eccentrically on an axle forty-five feet long and eighteen inches thick. As the axle turns, first one shoe and then the other moves to propel the drag-line ahead, seven feet at a step. Thus the 650-ton machine moves on its mechanical feet and walks smoothly across the desert sand without sinking in.

AN ARRAY of pneumatic controls, electric switches, throttles, and levers, makes the control room resemble the cab of a locomotive. Twenty-four men keep the big machine going day and night, eight men at a shift. In the forward part of the cab, behind glass windows, sits the man in charge. From his perch, the perspective is distorted as he looks down the barren slope of sand, so that distances cannot be accurately judged. He is peering intently before him. Far below, down the steep canal wall, the "pit man" waves his arms in a sweeping motion. He is talking in the private sign language by which the workmen communicate.

Around swings the cab on its pivoted base, rolling smoothly on the seventy dollies beneath its thirty-six-foot platform. The giant boom, a latticed steel girder, sweeps in a semicircle. It dips slightly.

The pit man is indicating a spot almost directly beneath the beam. The control man touches a lever. A steel cable, twice as thick as a man's thumb, begins to sing as it swiftly pays out. Down plunges the huge bucket, a scoop big enough to accommodate an ordinary automobile with room to spare at the sides. As it nears the designated spot, it hesitates slightly. Beam, cable, and drag-line work together to draw the bucket in and land it at the exact spot desired.

A heavy, shrieking chatter splits the air as the hoist engine goes into action. The drag cable, a steel sinew two inches in diameter, tightens, gouging the bucket into the sand bank. The scoop fills itself to overflowing, and begins its upward climb—slowly, laboriously, for with its load it weighs 50,000 pounds.

As it reaches the level of the embankment, the operator shifts his controls. The giant beam wheels smoothly, swings the bucket neatly above the embankment, and a seven-ton load of sandy earth cascades out of the scoop, adding its bit to the bulwark which is to check the movement of the shifting desert sands.

UNDER the scorching noonday sun, under the huge, desert moon, through summer heat and blinding sand storms, the work will go on. At night, the powerful glare of floodlights attached to the booms makes daylight where they work. Before water can flow, sixty million cubic yards of material must be excavated and hauled to its proper place—enough, loaded upon standard forty-foot gravel cars, to make a trainload 2,235 miles long, stretching from Chicago to Los Angeles.

But more than a colossal job of earth-moving, more than the biggest irrigation ditch ever built, is this huge gash engineers are cutting in the southern desert. In combination with Boulder Dam, it not only will bring life-giving water to parched desert lands, but will permanently end the menace of the millions of tons of water that thunder down the Colorado's steep-walled chasm.

For years, the Colorado has been a trouble maker in the West. From the northern plateau where sudden desert storms sweep across the barren mesas to discharge cloudbursts that race to join the river's brown torrent, to its mouth in the Gulf of California, where at times it creates some of the roughest ocean water in the world, it is a violent, powerful giant. Near its delta, where its rolling brown waters mingle with the blue of the ocean, it is sluggish but temperamental. News of rains in the mountains far to the north is brought by sudden, spectacular rises in the river's height at Yuma, where the government gauging station often records sensational jumps in the water flow within a few hours.

BUT the temptation of this precious fluid, going to waste, was too strong for dwellers in the thirsty lands near-by. At the turn of the century, farmers pierced the natural barrier separating the lower Colorado from the huge sink just to the north, in whose trough, far below sea level, lies the dead Salton Sea. The crude thirty-mile canal they dug brought the waters into a natural depression leading down into the Imperial Valley. But soon, in 1905, a flood crest suddenly swept down the river. The head gates controlling the flow of water stuck, and, before they could be released, the torrent surged madly through the newly excavated channel. For two years the runaway river, heavy with thousands of tons of silt, poured into the inland sea, raising its level seventy-three feet and swelling its area by 278,000 acres.

Though levees have since checked the flow and provided a measure of safety, the threat of flood has persisted. Even now, these embankments are in need of repair, and ordinary maintenance alone costs upward of $100,000 every year. With Boulder Dam cushioning the shocks of flood crests and the All-American Canal, with its diversion dam, as a valve to regulate the flow, the giant Colorado will be rendered as tame as a town waterworks system. Dredges no longer will be needed to remove the silt which constantly clogged the old canal, for the giant paddles of the washing machine will remove it.

ALREADY, Boulder Dam has begun its work as a good Samaritan. When, last spring, flood waters swelled the Colorado, rushing past the gauging station at Grand Canyon, Ariz., at the rate of 100,000 foot seconds, the heavy gates were lowered and its titanic bulk checked the flow, storing it for future use. The rising crest never reached Yuma to endanger the cracked levees. Soon afterwards, the floodgates were raised slightly and the impounded flood waters began to trickle down little by little as they were needed. Within a few weeks, enough water had been stored to meet the whole year's needs for irrigation, thus preventing a repetition of the 1934 drought which cost Imperial Valley farms a loss of $10,000,000.

ELECTRIC SHOCK USED TO REVIVE DYING MAN

SUCCESSFUL use of a heavy electric shock as a means of saving life was reported at a recent meeting of the American Institute of Electrical Engineers. An account of how a surgeon, sewing a gash in a man's heart, revived the patient after the heart stopped beating was given by Dr. Kowenhoven of Johns Hopkins University, Baltimore, Md. The method was developed at university's laboratory after many experiments on counter-shocking animals to revive them after they had suffered electric shocks. Experiments along this line have indicated that the method may be of assistance in reviving drowned persons.

HOW TO MIX AND APPLY SHINGLE STAINS

(Continued from page 74)

ing another coat or stain. This is about on a par with a good coat of paint, hence will cost rather less, figuring about 300 sq. ft. of coverage per gallon under average conditions of surface and brushing.

For a job of this kind, you will need several sizes of stepladders and ladders. If these are your own property, the straight ladders should be fitted with safety spikes at the bottoms as shown in one of the illustrations. These are made from cold-rolled, flat steel 18 by 1½ by ¼ in., cut with a hack saw to form 4-in. long points, and drilled for two ¼-in. carriage bolts.

IT WILL be a real surprise to find out how easy it is to raise a spiked ladder, even one of the heavy extension type. With such ladders, even the most timid feel safe, knowing that they cannot skid on a slippery lawn or hard-packed drive. Without the spikes it is almost an impossibility for one man to handle an extension ladder safely. With them, the double ladder may be brought to a vertical position and held against one knee; then both hands are used to haul on the rope while the upper section is being elevated.

Next, paint hooks are necessary. These can be made from any rather stiff wire such as No. 9 or 10, or even from discarded clothes hooks. Bend one loop end to go over the ladder rung, and make the other smaller to snap tightly over the handle or bail of the paint can.

Brushes for shingle staining must be of good quality, rather wide, with bristles at least set in rubber. If you have large hands and strong wrists, then a 6-in., long bristle wall brush will suit you. On the other hand, if you are an office worker, it will be more in keeping with your softer muscles and hands if you use a 4-in., medium length wall brush.

Before starting to stain the shingles, it is best to protect the hands. Rub the hands and especially the finger nails full of clean gear grease, vaseline, or even lard; then wipe the palms quite clean on a dry cloth so that the hands will not be slippery. Later on, a mild, abrasive hand-soap or cleaner may be used to remove the grease

Fill the pail half full of the thinned paint, snap on the pail hook, and go to the top of the ladder or as far as necessary to start staining at the top of the wall. Dip the brush an inch or two into the stain, slap it against the inside of the pail to knock out the excess paint, and then start to "cut in" along the cornice line or the window-case molding as shown in the photo. Next, see to it that all butts of the shingles are well stained; then cross brush the faces of the shingles. After four or five feet of surface have been brushed in, wipe the brush dry on the edge of the pail and "lay off" the faces of the shingles with a light stroke run from the top downward so that all parts are even in color and free of brush marks and runs.

IT IS a difficult thing for the inexperienced worker to prevent the thin paint from running out of the brush and down his arm. To control this, dip only an inch or two of the brush, slap it against the inside of the pail to remove all excess paint, and as often as practical hold the handle higher than the bristles. Some men prefer to keep two brushes going for alternate periods. When not in use, the extra brush hangs with bristles downward so that any paint in the heel drains down to the tips of the bristles. This is often the only solution when the brushes are used all day long.

As the work progresses, inspect carefully to see that any runs, caused by the paint's being dragged out of the brush as it crosses the crack between two *(Continued on page 126)*

HOW TO MIX AND APPLY SHINGLE STAINS

(Continued from page 125)

shingles, are brushed out. It is well to back down a step or two on the ladder from time to time and look up at the fresh surface. This inspection is quite worth while and may save replacing the ladder after it has been moved, in order to touch up or brush out any portions not properly coated.

Throughout the entire process of staining and painting, any flowers or shrubs bordering the foundation lines should be protected with a light but closely woven cloth such as unbleached muslin. In case the material is too heavy for the flowers to stand up under, use large sheets of heavy wrapping paper. In any case the plants must be protected because paint spots will "burn" them badly. When conditions will permit, a pair of sawhorses, with a plank and paper over all, will do much to help protect valuable plants and blooms without doing any harm to the beds.

IF YOU have wooden shingles on the roof and wish to stain them, a safe way to go about the work is to use the two separate 20- or 25-ft. sections of an extension ladder. Put on a good pair of tight-fitting rubber overshoes—not an old pair that fit loosely and may cause an accident. By no means try to walk on a shingle roof with leather soles, as they become very slippery after the first few minutes. Take the two ladder sections to the roof, with one length on one portion and the other directly opposite on the other side. Lash the top rounds together with strong rope which you are certain is in good condition. One inch Manila (measured as the circumference) or sash cord is suitable. Two ladders lashed together at the top provide flexible means of traversing the roof with two men working at a time, or one man can do the work in alternate strips, although the appearance is not apt to be quite as uniform as when two men team up and do the complete job together.

Be sure to start on the gable end *opposite* the ladder to be used in leaving the roof job. Start at the top and brush on the stain evenly. Roof stains should be made from three parts of full-bodied paint reduced with only one part of thinner. The heat and penetration will be greater as will the exposure to the elements, so the material needs to be correspondingly tougher and more durable.

When the last two strips are ready to coat in, move the ladder to the *last* strip, paint in the next to the last, and then cover this section with the ladders while brushing the last section. In this way you can coat all the roof without working yourself off, as it were.

Make certain that all chimney and vent flashings are well covered. Be careful about lapping the paint over the brickwork of the chimney. Last of all, see to it that the ridge is sanded clean of rust, if made of metal, before painting and then coat over it as for the shingles.

OCCASIONALLY the weather will be hot and the shingles quite dry so that the paint is absorbed very fast. If while painting a succeeding strip, the brushwork should get over on the previous area, the paint will have "set" enough so that the laps are, to all intents and purposes, second coat material. This uneven effect can be avoided by brushing the edge of each area so that it stops on a line of joints up and down the entire strip of roof. By working up to the cracks and not across the joints, lapping of stained areas can be avoided, and an even application will be possible if you are careful.

As the staining progresses and while the ladders are all on one side of the house, trim the windows, sash, and blinds. These matters will be discussed in a later issue

HOME EXPERIMENTS SHOW BEHAVIOR OF IODINE

(Continued from page 55)

of cupric chloride, made by dissolving fifteen grams (about three teaspoonfuls) of the substance in fifteen cubic centimeters of water, in the cooling vessel. A few cubic centimeters of the cupric chloride solution may also be added to the U tube if desired. No red phosphorus is used. An empty test tube or bottle should be inserted in the train of apparatus between the gas-generating flask and the cooling vessel. When measuring small amounts of liquids, one teaspoonful can be considered as being the equivalent of three and one half cubic centimeters.

HEAT the generating flask gently. Ammonia gas and some water vapor will be driven off, the latter condensing in the empty test tube or bottle. The ammonia bubbles through the cupric chloride solution, which should be cooled, meanwhile, with the can of ice water. When the cupric chloride solution has become azure blue in color, add about ten cubic centimeters of grain alcohol or rubbing alcohol and continue to pass in ammonia gas for a little while. Then remove the cooling vessel and filter its contents. Wash the solid material with a small amount of alcohol while it is still on the filter paper, and let it drain. The beautiful blue crystals quickly decompose, liberating ammonia gas, and they should be bottled immediately to keep them as long as possible. They consist of a compound known as tetraminecupric chloride. Vivid bluish-green hues are produced when they are placed in a Bunsen flame.

Another colorful compound of ammonia is ammonium dichromate (or bichromate), and you can easily show the curious behavior of paper dipped in a solution of this chemical and then dried. Fifteen grams of ammonium dichromate dissolved in 100 cubic centimeters of water makes a solution of suitable strength; the paper may be of any sort at hand.

Fold a sheet of dried, impregnated paper in the shape of a fan and light its upper edge. The paper will smolder and burn, producing peculiar featherlike formations of green ashes. They consist of chromic oxide, which is used commercially to make green paint and to give glass a green color. Another product of the decomposition of the ammonium dichromate, in this reaction, is nitrogen gas. The effect may be varied by adding a few grams of potassium nitrate to the ammonium dichromate solution in which the paper is dipped; this will make it burn faster.

If you soak paper in ammonium dichromate solution and let it dry in a dark room, you will find it sensitive to light, like a photographic emulsion. Expose a sheet to strong sunlight for several seconds, beneath a stencil or a piece of lace, and the pattern of the stencil or lace will be imprinted upon it.

THE paper is unequally sensitive to light of various wave lengths. Rays of blue, violet, and ultra-violet light affect it particularly strongly, while red light produces almost no response. An interesting way to show this is to set up a sheet of the sensitized paper and throw a spectrum upon it, from a sixty-degree glass prism placed in the sun. After a minute or two the paper will be found discolored at all points along the spectrum except where the red rays have fallen upon it.

AIRPLANES TO HUNT FOR ANCIENT WELLS

LONG-LOST wells, used centuries ago by Roman legions in what is now the British mandate of Transjordan, will be hunted by planes in an air survey planned by English explorers. If located, the wells may be reopened to serve as supplies for irrigating the desert land.

AMAZING FEATS OF SURGERY PERFORMED IN NAVY'S FLOATING HOSPITAL

(Continued from page 25)

crowded conditions on board ship favor the spread of contagious diseases. The intricate machinery among which the men work and live carries its own hazards of injury. Powerful explosives which they handle, and the tremendous forces which are harnessed on a modern ship of war, add their dangers to those which usually threaten men who follow the sea. Add to these the frequent and extreme changes in climate to which the crews are exposed, and you will realize that the naval doctor must be able to handle any problem in medicine, surgery, sanitation, or any of the specialties."

EACH of the Navy's powerful battleships carries two medical officers; cruisers have one each, the large aircraft carriers, four. These doctors handle cases of mild sickness or injury, and in an emergency perform in the completely equipped operating rooms feats of surgery which cannot be surpassed in modern hospitals ashore. Aboard each ship, also, is carried a two-year supply of dressings, drugs, and instruments. Thus, medically as well as physically, each unit in the fleet can operate for a long period away from its base.

It is aboard the *Relief*, however, that the Navy's major surgery at sea is performed. While there have been hospital ships attached to the great navies ever since the days of the Spanish Armada in 1588, this hospital ship is the first ever to be built from the keel up for this special purpose. The *Relief* was commissioned in 1920, and has since been in almost constant attendance on the fleet, curing the sick and returning them to their ships as quickly as possible, and providing special treatment, laboratory facilities, and other medical needs.

The *Relief*, which usually may be seen riding at anchor immediately inside the breakwater in Los Angeles Harbor, accompanies the fleet during its longer practices at sea. Yet, within the protected waters of a bay or on the ocean, her officers, nurses, and hospital attendants are always ready for emergency service. In the storeroom is a complete field hospital, ready to be set up and to serve on a few minutes' notice with an expeditionary force ashore.

This mobile emergency unit includes doctors, dentists, pharmacists, nurses, and Hospital Corps men, plus a fifty-bed tent hospital, supplies and food for three days, a complete operating room, and a laboratory. The mobile hospital stands ready at all times to go ashore not only with a landing force from the battleships and cruisers but also to aid the civilian population after a disaster.

Though the list of supplies—from cots to medicine—may seem complex and long, in a recent test the complete hospital was broken out from the hold in thirty-eight minutes, and within three and one-half hours was ready to receive patients ashore.

THE field hospital is strictly an emergency unit, and more than once doctors have left the floating hospital to bring succor to stricken civilians.

At 5:55 p.m. on March 10, 1933, as the hospital ship rode at anchor in Los Angeles Harbor, an earthquake struck Long Beach, Calif., and vicinity. In a few minutes, 125 persons lay dead under crumbling walls. Quickly the call went out for medical and surgical help from the Navy.

Medical officers were recalled from their homes to battleships, cruisers, and the *Relief*. An hour or so later, medical units were bouncing across the choppy waters of the harbor for the mainland. From the *Relief* alone, five surgeons and thirty-nine Hospital Corps men accompanied the field hospital or went into civilian hospital wards, dressing rooms, laboratories, operating rooms, and dispensaries to lend aid to overworked local staffs.

On this and many other occasions, naval surgeons have risked their own lives to save others where a delay of minutes meant certain death. Yet their names never reach the public prints.

One surgeon, for instance, on seventeen occasions has given his own blood in transfusion, then proceeded to perform delicate operations. In only one case was the patient aware that the operating surgeon also gave his blood.

HERE is the most dramatic of those seventeen cases. While on duty, Thomas J. Marshall, a seaman on the battleship *Texas*, was suddenly crushed by a falling davit. Rushed to the *Relief*, his arm was found to be useless and the man nearly dead from loss of blood. Perceiving that there was no time for blood tests, the senior surgeon, knowing he belonged to the universal group of those who can donate blood to anyone, opened a vein and transferred blood at such a rapid rate he fainted. Revived a few minutes later, the weakened surgeon had himself lashed by ropes to the operating table, and proceeded to amputate the injured arm.

The influence of the Navy's medical men is felt around the world. Wherever the marines go, medical officers from battleships and the *Relief* go with them—into Peiping, Samar, Belleau Wood. As soon as the marines land, Navy doctors move in to improve sanitation, render medical aid to the civilian population, and attend needs of the fighting men. In fact, Navy medical men have performed notable services to the world at large, from bringing the dread yaws under control to combating gangosa, beriberi, malaria, intestinal parasites, and other tropical diseases.

Far smaller than the average hospital, the *Relief* is filled with all the mechanical and scientific appliances needed to care for the men and officers of the fleet. With a capacity of 360 sick and injured, she can take care of 500, ministering to everything from broken arms to insanity. Dietetics, electrocardiography, and neuropsychiatry are studied and practiced by skilled medical men.

So busy is the *Relief*, that seldom does a day pass when fewer than half of her bunks are filled. Last year, 417 major operations were performed in the main operating room, with 516 nose and throat operations in the secondary surgery. Add to these figures 11,814 laboratory examinations, 4,367 X-ray studies and treatments, and 4,472 physiotherapeutic treatments, and you get some idea of the work done aboard her.

IN ONE year, the Navy has as many as 42,000 sick days, equivalent to having 1,378 officers and men all ill for a solid month. During a seven-months cruise, 1,298 men boarded the *Relief* for medical and surgical attention. They stayed an average of twenty-one days each, yet four fifths were returned to duty, cured. Here the doctors preserved enough personnel to operate one battleship or eight destroyers.

But her medical officers do not stop with treatment of individuals. Her medical personnel provides specialists for consultation by the 216 medical officers of the combatant ships, which lack the elaborate equipment of the *Relief*. Specialists undertake laboratory work, such as the examination of cultures, manufacture of vaccines, analysis of water, milk, and food—everything, in short, to keep Uncle Sam's sailors physically fit and ready for any emergency.

This One

N2RO-NOQ-7BYQ

ARE YOU WASTING GASOLINE?

(Continued from page 60)

asked in surprise. "I do it often just to make sure the motor is running when I'm in heavy traffic. The blamed thing is so quiet that I can't tell whether it's stalled or not. Besides, it seems to make the get-away easier, somehow."

"Did you do it with your old car?" Gus asked.

Featherston smiled. "I didn't need to. You could always tell whether the motor was running, by the noise and the vibration. And, if you did hit the throttle quick like that, it usually popped back on you."

"THAT'S just the point," Gus insisted, as he took down a coil of copper pipe and unbent a length of it. "Modern carburetors are fitted with a tiny pump hooked to the throttle in such a way that when you push down the throttle suddenly, a lot of extra gas is forced into the mixture. So, when you have to open the throttle quickly, the motor gets extra gas and takes hold with a strong, steady pull, instead of bucking and popping like the old-style carburetors did when they were set for a fairly thin mixture. Now, when you push down on the throttle two or three times in quick succession before making a start, the mixture gets so thick you can actually see black smoke come out of the exhaust. A fellow can waste a lot of gas that way, so you'd better cut it out.

"As a matter of fact," he added, "if you want good gas mileage with *any* kind of a car, you'll let it gain speed slowly without opening the throttle more than necessary."

"Are there any other points about driving a modern car that'll help to improve the gasoline mileage?" Featherston inquired.

"None about the driving that wouldn't apply to old cars," Gus replied, as he reached over to make the connection at one end of the vacuum pipe line, "but there are several points about the new cars that you want to keep in mind if you're after fuel economy.

"One of them is right here," he said, as he rested his hand on the air cleaner. "If you let this gadget get so dirty it doesn't let the air through freely, the effect is a little bit like riding with the choke on a trifle all the time, so that more gas will be pulled through the carburetor jets and you'll get a slightly rich mixture."

"Another new-fangled gadget to worry about," laughed Featherston. "It's up to me, I guess, to keep it clean. At least, it's easy enough to see when it needs attention—or shouldn't you let it go till you can see the dirt?"

"YOU can let it go till it begins to look gray and dusty, but don't wait till it's all caked up," Gus advised. "And be sure you oil it, too. It may seem like a lot of trouble to clear out the air cleaner now and then, but it's a lot cheaper and easier than to have the car laid up while you have new pistons and rings put in. Every bit of grit that gets into the cylinders with the air through the carburetor may help to form carbon, or else mix with the oil and form a mild grinding compound that wears away the cylinder walls, the pistons, and the rings. Lots of times your business gives you occasion to drive on unpaved dirt roads where the dust rises in clouds and the air cleaner is the only thing that stands between you and a whopper of a bill for the repair of a motor worn out all too soon.

"There's another point about modern cars that can cut down the mileage, and you can spot it right away. That is the condition of the tail pipe. In modern cars, the tail pipe that carries off the exhaust gases is so long that it reaches beyond the body in some cases. The object in *(Continued on page 130)*

ARE YOU WASTING GASOLINE?

(Continued from page 129)

making it long that way is to shoot the gases out where they won't have any chance to drift up into the body of the car. Exhaust gases are bad medicine. They always contain a lot of carbon monoxide, and that's a deadly poison.

"The only trouble with having the tail pipe go back so far," Gus continued, "is that if you happen to back into some rubbish, or a pile of rocks, or anything like that, the end of the pipe may be folded up so that the gases can't get out freely. Then you have back pressure and high gas consumption, to say nothing of loss in power. A brand-new car stopped by here only yesterday with the tail pipe closed up to a small crescent of an opening that made the gas hiss as it came out. So, if you happen to back into anything, be sure to take a look at the exhaust pipe."

"THAT'S one new-fangled idea that obviously is worth while," Featherson remarked. "Any improvement that will help to keep carbon monoxide out of the car may be a life saver."

"There are at least two more old-time troubles that you can't spot by just looking around," Gus went on. "One of them is a high carburetor-float level. If the gas level is too high, there'll be too much gasoline drawn through the jets, and the mixture will be a little rich and not so economical. In the old days, when a carburetor got that way, you could spot it quick enough because the gas would leak out and you could see it dripping—and smell it, too.

"Now, with the modern down-draft carburetor, the leaking gas goes down into the intake manifold and there isn't any outside indication. Of course, with the modern fuel pump, the gas stops feeding to the carburetor as soon as you stop the motor, so only a little gas can leak before the level drops to where it ought to be."

"How about a leaky float valve or a float that leaks and sinks and doesn't shut off the gas? How can you locate that kind of trouble?" Featherston asked.

"There isn't any such thing as trouble from a leaky float valve any more," Gus smiled, "That's one form of grief that modern construction has wiped right out. In the old days, when you got a leaky float valve, the gas level in the float chamber would rise as soon as you stopped, till it reached the level of the jets. Then it would leak out, and keep on leaking out till the vacuum tank was empty, so that even a small leak meant quite a lot of gas lost. Now, with a fuel-pump feed, the fact that the gasoline float valve is leaking doesn't mean anything unless the leak gets so bad that the valve leaks gasoline faster than the motor takes it out of the float chamber at idling speed. When the motor stops, the leak stops too, because the fuel pump stops supplying gas.

"IN THE case of a sunken float, you'll know it quick enough," Gus concluded, "because the fuel pump will fill the float chamber right to the top and then begin squirting gas into the manifold so fast that the motor will choke up and stop."

The two men got into the car again, this time with Featherston at the wheel. "Seems to have a bit more pep," he observed, "but I can't see a great deal of difference."

"You'll see an improvement in the gas mileage, I'll bet," Gus promised.

"I hope so," Featherston said, "but some of the old-timers were economical too!"

"Sure," grinned Gus, "but why try to compare a lion with a mouse? How many 100-horsepower old-timers could come anywhere near equaling this bus for gas economy?"

HOW TO GET ALL THE POWER

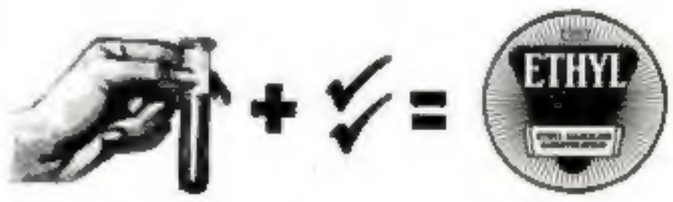
YOU LOSE power when the factory spark setting of your engine is *retarded—whatever kind of gasoline you use.* You lose power even when the spark is set for maximum power—if the gasoline knocks.

And knock is *expensive.* It means that you are tossing away good money in gasoline and oil—and that you are getting *less* power than your car was built to deliver. For knock wastes all three—gasoline, oil and power.

TO FIGHT THE KNOCK EVIL, with its waste and expense, most oil companies now use anti-knock fluids (containing tetraethyl lead) made by the Ethyl Gasoline Corporation.

And for cars built in recent years, with their high compression engines, these oil companies offer a special high compression fuel at pumps marked "Ethyl."

HIGHEST ANTI-KNOCK! At the Ethyl pump you get a special motor fuel of highest quality on every count in which enough anti-knock fluid has been *blended* to stand the highest compression and the full-power spark setting of your car.



And both the anti-knock quality and all-round value are *double-checked*—by the oil companies and the Ethyl Gasoline Corporation—at the refinery and at the pump.

START A REAL SAVING in your car's operating costs. Have your spark set at factory specifications for *maximum power.* Then fill up with Ethyl. See how much gas and oil you save. See how much better your car will run!

NEXT TIME GET ETHYL!